SCIENTIFIC AMERICAN

Phosphorescent Air Craft

Difficulties of a Transatlantic Flight

Crossing Greenland's Icy Mountains

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

A Perpetual Electric Current

IT is true of some discoveries—not of all—that after they are brought to light they seem almost self-evident. What must happen if an electric current is started, say by induction, in a closed circuit having a vanishingly small resistance? The energy is not dissipated as heat, since the heat produced is proportional to the resistance, in this case zero. There is no other obvious way in which energy would be dissipated, and the only conclusion left open to us seems to be that the current would continue indefinitely.

That this hypothetical case should actually have been realized must be a surprise even to anyone who may, at some time or other, have gone through the argument given above. Yet this is what has happened. Prof. Kammerlingh Onnes, the Dutch physicist, famous for his researches on low temperatures, has shown that several metals, when cooled to a definite temperature, low, but still above the absolute zero, cease to have any measurable resistance, and that a current started in a lead coil by induction continues indefinitely so long as the coil is kept cooled with boiling helium. Such a coil behaves like a permanent magnet, deflecting a magnet needle brought into its neighborhood. If the coil is connected up to a galvanometer there is an instantaneous deflection, and the current dies out in the circuit, which now includes a resistance.

In Prof. Kammerlingh Onnes's experiment a lead coil was used, which at room temperature had a resistance of 736 ohms. In liquid helium the resistance fell to less than a twenty-billionth of this, and the current was over one half ampere. At 6 degrees absolute there is a somewhat abrupt fall in the resistance of the lead, to practically zero. For each of several metals tested there is such a point. In the case of mercury it is 4.2 degrees, for tin it is 3.8 degrees absolute.

It had been the hope of physicists that very low temperatures would furnish us a means of producing very powerful magnetic fields, by the use of conductors cooled to very low resistance, and carrying large currents. But in this they have met with some disappointment. It has been found that when the cooled conductor is placed in a strong magnetic field, its resistance once more rises to a finite value.

Prof. Kammerlingh Onnes's discovery is, at any rate from the point of view of pure science, one of the most remarkable events in the progress of science during an epoch abounding with important developments. Whether it will have any direct practical application it is impossible to foresee at present, but indirectly, through the increase in our understanding of matter and electricity which is bound to follow from this discovery, there can be no doubt that many important material advantages will be gained.

Wilkes Land Up to Date

WRITING in the *Scottish Geographical Magazine* for June, 1912, Dr. W. S. Bruce, the well-known Scotch explorer and geographer, summarized the principal achievement of the Mawson Antarctic expedition by saying that it "has proved, over a distance of more or less 1,200 miles, the existence of Wilkes Land, which has been disputed during the past seventy-two years, and has set up stations at the west, and almost at the east end of it."

In this statement Dr. Bruce used the name "Wilkes Land" in its generally accepted sense, as designating the whole coast of the Antarctic continent lying between Victoria Land on the east and Kaiser Wilhelm Land on the west, or say from longitude 95 to longitude 160 east. The name is so defined in Lippincott's Gazetteer, in Meyers' Konversations-Lexikon, and in scores of other reference books of international standing. It has also been used in this sense on many British charts, dating back at least to 1856. Moreover, and what is more to the point, no rival name has ever been proposed for this coast as a whole, unless we except the name "Antarctic Continent," which Wilkes himself inscribed on the map of this region, but presumably without intending to imply that the "continent" was limited to the coast sighted by his expedition.

The propriety of giving Wilkes's name to this land need not be discussed here, and much less is it necessary to review the long-protracted disputes regarding the merits of Wilkes's discoveries, beyond saying that the Mawson expedition has certainly yielded much more accurate knowledge of the coast-line in question than was available a few years ago. The essential fact is that the name has been widely used for more than half a century, and cartographers who did not like it have never seen fit to replace it with another.

The only exception to the last statement that has come to our notice is a map published in *Nature* of March 5th, 1914, in which the name "Wilkes Land" is, indeed, printed in its proper place, but in type which may be most fittingly described as "evanescent," while in large, bold letters the new name "King George V Land" is spread over the same region.

Turning, now, to *Nature* of July 2nd, 1914, we find the first comprehensive published account of the Mawson expedition that has come from Mawson himself, in the form of an extract from a paper read by the explorer before the Royal Geographical Society. The paper contains the following statement: "The new land east of the Mertz Glacier we have received his Majesty's gracious permission to name King George V Land." From the context it appears that the Mertz Glacier, discovered by Mawson, lies somewhere about longitude 155 east; hence we find that Mawson had no idea of giving the name "King George V Land" to the whole coast explored by the two sections of his expedition, but merely to a comparatively small area lying just west of Victoria Land. The chart of March 5th, above mentioned, was, therefore, misleading in conveying the impression that the explorer had renamed a region that was named long before he was born; and the name "Wilkes Land," as applied to the whole coast, still remains without a competitor.

We regret, however, to learn that Sir Douglas has taken another method of removing this name from its time-honored place on the map—a method that was either ingenious or ingenuous, we cannot be sure which, though we strongly suspect the former. In describing Davis's westward voyage in the "Aurora" after leaving Mawson and the main party at Commonwealth Bay, he mentions that the vessel sailed over the charted position of land east of Wilkes's Cape Carr, finding no trace of land. He proceeds: "A few hours afterward, still steaming south, new land was sighted to the south—icy slopes rising from the sea similar to those of Adelie Land, but of greater elevation. To this discovery we gave the name of Wilkes Land, to commemorate the name of a navigator whose daring was never in question, though his judgment as to the actuality of *terra firma* was untrustworthy."

In other words, Wilkes Land, by the grace of Mawson, is a minor patch of coast of the same order of magnitude with Adelie Land, Clairie Land, Sabrina Land, and the numerous other "lands" which, collectively, constitute the Wilkes Land of yore! What next?

The Down-trodden Inventor

IN last week's issue of the SCIENTIFIC AMERICAN we referred to the autographic kodak invented by Mr. H. J. Gaisman—a camera attachment which makes it possible to write a caption or signature on a photographic film immediately after a picture is taken. Writers of novels who love to picture the weary and hopeless struggles of the inventive genius with grasping monopolists, who look upon a moneyed manufacturer as a fat spider craftily waiting in the center of his web to dart upon a foolishly adventurous fly of an inventor, will learn with disappointment that Mr. Gaisman—still so young that one would imagine him to have fallen a ready prey to the wiles of capitalists—has received $300,000 from the Eastman Company for his comparatively simple invention.

It is bad enough to have "romance" shattered in this way. But what shall be said of the company that pays this sum of money to make the inventor independent, to leave him free from all cares, so that he can devote himself whole-mindedly to his inventions? "I would have taken $10,000 for my work and would have jumped at $50,000," the inventor is reported to have said. But there was no haggling. Every possible expense which had been incurred was deliberately taken into account. First of all, there was the value of the inventor's time for the four years which he worked on his device, for which a sum was set aside, and then doubled as an element in fixing the price. Then came the cost of the laboratory in which the inventor worked. That, too, was doubled. And lastly, enough was added to make Mr. Gaisman independent.

Whenever we shall hear the story of the man who invented the ubiquitous monkey wrench and who lived to be buried by a few sympathetic friends, we shall tell the story of Gaisman and his autographic camera.

A National Seismological Service at Last

THE Agricultural Appropriation Bill, approved June 30th, 1914, grants to the Weather Bureau the authority that it has long sought to carry on investigations in seismology. Thus the United States falls in at the tail of the procession of countries in which the study and recording of earthquakes have been recognized to be as much incumbent upon a government as the recording and study of weather. The two fields of activity, while not closely related to each other in a scientific sense, are analogous in many respects, and the common custom of intrusting seismological work to a meteorological bureau is a measure of convenience. The Weather Bureau possesses about two hundred regular stations, well distributed over the country, and manned by paid observers who give all their time to the Bureau's work; also several hundred special stations at which the observers receive a small compensation for performing specified duties; and finally about forty-five hundred so-called "co-operative" stations, with unpaid observers. This Bureau is, therefore, ideally situated, as compared with other scientific bureaus of the Government, for inaugurating a system of instrumental and non-instrumental observations of earthquakes throughout the country without materially increasing its present operating expenses.

Several years ago the American Association for the Advancement of Science passed a resolution urging on Congress the plan of installing seismographs at a few of the more important Weather Bureau stations. Later a bill was introduced into Congress to establish a bureau of seismology under the Smithsonian Institution. Neither of these plans secured congressional sanction. Finally, in 1912, a decision of the Comptroller of the Treasury debarred the Weather Bureau from carrying on the work in seismology which it had undertaken on a modest scale without waiting for specific authority from Congress, and since that time the Bureau's unique seismograph, installed at its Washington office, has remained idle; i. e., its valuable records have been locked up in the Bureau's archives, instead of being communicated to the world. Fortunately this anomalous situation is now at an end.

It is understood that the Bureau has not funds for immediately undertaking instrumental observations of earthquakes on an extensive scale, but this will come in time. Meanwhile it is proposed to inaugurate at once a system of non-instrumental observations, so that the obvious features of sensible earthquakes will be recorded and promptly reported to headquarters. Thus it will be possible to locate the sections of the United States where seismic motion on existing fault lines is taking place with some frequency and regularity; a matter of great importance in connection with certain kinds of engineering works, especially those relating to great water supply projects or similar undertakings where it is necessary to provide against possible injury from earthquake movements. Perhaps the day is not far distant when the United States will possess a seismological organization comparable to that of the little empire of Japan, which includes more than fifteen hundred observing stations, at least seventy of which are equipped with modern recording apparatus.

The seismological work of the Weather Bureau has been placed under the supervision of Prof. W. J. Humphreys. The present chief of the Bureau, Prof. C. F. Marvin, is a seismologist of wide reputation.

The Variations of Daylight in Greenhouses and kindred phenomena have been investigated in a very thorough manner by Prof. G. E. Stone of Amherst, Mass. The measurements of light intensity were made with a form of chemical photometer, and are, therefore, applicable to the study of photolytic phenomena in plants. Prof. Stone found that morning light was, on an average, 10 per cent more intense than afternoon light. This difference varies with the season, in some months reaching 30 per cent. Hence, other things being equal, a crop will show a greater development on an east than a west exposure. The light-transmitting properties of different kinds of glass vary greatly. Thus the loss of light from glass as compared with outdoor light ranges all the way from 13 to 36 per cent or more. The practice of lapping the panes causes an average loss of light of about 11 per cent. The transmission of light naturally increases as the angle of the roof more nearly coincides with a right angle to the sun's rays. The reflection of light from surfaces is another important factor.

Electricity

A Tower Higher Than the Eiffel is in course of construction at Brussels, and is designed for use as a wireless telegraph station, and for meteorological purposes. It will be 1,093 feet in height, while the height of the Eiffel Tower is 984 feet.

Electric Resistance of the Skin.—Prof. Von Pfungen is engaged with experiments in his laboratory at Vienna upon the resistance which the human skin affords to the electric current. He operates by passing the current through the body from one hand to the other and measuring the amount by a sensitive galvanometer. His researches bear upon the relation of the state of the nervous system to the electric resistance of the skin, and he claims that nervous excitement of any kind lowers the protecting power of the skin to quite a marked extent.

Resistance Alloy.—A new alloy for use in making electric resistance has been lately put on the market in Germany, and is said to be of great use in case the resistance wires or strips need to be worked at a high heat; for the new alloy of chromium and nickel can be run at even a bright red heat without suffering damage, and such heating does not make the metal brittle upon long use. Specific gravity of the alloy is 8.25, and it has a specific resistance per meter length and square millimeter section of 1.10 ohms. It can support a temperature of 1,110 deg. Cent. on constant run. The melting point is 1,400 deg. Cent.

A National Committee for Telegraphic Research.—A committee appointed by the Postmaster General of Great Britain recently recommended that a national committee for telegraphic research be established to promote the progress of telegraphy and telephony by theoretical investigation and experiment. It was also recommended that a national research laboratory be established with a special scientific staff. It was pointed out that both in Germany and in the United States a more liberal provision is made for research and experimental work in wireless telegraphy. In this country, the Navy, the Army Signal Corps and the Bureau of Standards cooperate in such work, while in Germany the work is carried out by the Post Office.

Electric Vehicle Day.—In order to give the public some idea of the extent to which electric vehicles are used it has been proposed that some day, preferably a holiday, be appointed as an electric vehicle day when, in the various centers throughout the country, there shall be a parade of electrically equipped vehicles, and prizes offered for the best decorated commercial and pleasure vehicle. The suggestion comes from Robert Montgomery, manager of the Louisville Gas & Electric Company. It is interesting to note that in England, at the recent Municipal Electrical Convention held in Birmingham, there was a parade of electrical vehicles which proved a decided success, and focused the attention of the public on the convenience of this newer type of motor vehicles.

Primary Battery Patent.—A recent French patent relates to a primary battery of the Leclanché type, in which the positive electrode uses a mixture of dioxide of manganese and graphite, but the new method replaces the graphite by lamp-black obtained from the decomposition of acetylene. When acted upon by an electric spark discharge, gaseous acetylene decomposes to hydrogen and carbon, thus giving a chemically pure carbon. Its density is only 0.9 while that of graphite is 2.17 to 2.20. In this way it is possible to increase the proportion of dioxide of manganese and obtain a more regular working of the cell than with natural graphite whose composition is variable. The finely divided state of the acetylene carbon also gives a more intimate mixture with the dioxide, and hence a better result. Another patent relates to a method of working batteries of the above type so as to use considerable current from them and at the same time not run the battery down. The inventor treats the usual dioxide and graphite mixture by adding to it an oxide of mercury, preferably red mercuric oxide, and in such case the output of the cell may be increased several times and the battery can thus give heavier currents than before, holding up the voltage at the same time. He still further strengthens the battery by using an alkaline electrolyte such as caustic soda or potash.

Denatured Electricity.—An interesting method of preventing the improper use of electric current has been devised by an Italian engineer. The practice of making especially low rates for current to be used in electric power, heating and cooking devices is becoming more and more general, but with the ordinary constant potential current it is difficult to detect the use of lighting devices on circuits intended only for power and heating purposes. This engineer advocates the use of special circuits on which the current is subject to extreme fluctuation of voltage at rapidly recurring intervals, which would make it practically impossible to use lamps, because of the flicker in the lights. As the current is not entirely interrupted and the normal voltage is almost immediately restored, the proper operation of power or heating apparatus is not interfered with and the rightful use of the circuits for their respective purposes is assured.

Science

A Rare Optical Phenomenon was observed by G. Isely at the Observatoire du Jorat, Switzerland, on March 12th, just after sunrise, when the sun was seen to be accompanied by two mock suns, one above and one below it, each at a distance of about 2 degrees from the luminary. This phenomenon is explained by Pernter as a form of mirage. The classical example of its occurrence is that described and drawn by Hevelius, in 1682. (The drawing is reproduced in the Scientific American Supplement of November 16th, 1912, p. 309.)

Miners' Lungs.—It is well known that those engaged in occupations in which much silicious dust is produced (e. g., potters, certain miners, etc.), suffer from a form of lung disease. Dr. McCrae has analyzed the lungs of such cases occurring in the Witwatersrand mines in South Africa, and has published his results in the South African Institute for Medical Research. He finds that from 2.8 to 9.6 grammes of silicon may be present, compared with 0.55 gramme in a normal lung. Microscopical examination of the silicious particles showed them to be angular, and the majority had a very small diameter.

The Corrosion of Aluminium.—Recent researches prove that aluminium is subject to two kinds of corrosion: one of these resulting from a uniform attack all over the surface, while the other is localized in scales and spots. It is to be noted that the second case is generally produced upon metal which is mechanically worked by drawing or rolling. As in the case of iron, it seems that the metal must be exposed to air and dampness at the same time, for one alone will not produce it. Carbonic acid is a leading element in the corrosion. Worked aluminium scales off in the direction in which the mechanical action has been carried out.

Henri Poincaré.—Prof. Mittag-Leffler has taken the initiative in starting an international subscription for the striking of a medal bearing the effigy of Henri Poincaré, the famous French mathematician, lately deceased. Gaston Darboux, in order to perpetuate the memory of the great mathematician, has proposed the foundation of a prize to be awarded by the Académie des Sciences to young mathematicians. A committee has been constituted which counts among its members the chief notabilities of Science, Letters and Politics. Subscriptions are received by Paul Appell, Etienne Lamy and Gaston Darboux. The treasurer is M. Ernest Lebon, 4 bis, rue des Ecoles, Paris.

A New Method of Setting a Mercury Surface to a required height, as, for example, in setting a mercurial barometer with adjustable cistern, is described by M. H. Stillman, in a publication of the Bureau of Standards. The ordinary method of setting a barometer is to screw up the cistern until the ivory point representing zero of the scale makes a visible dimple in the surface of the mercury. The improved method consists in placing a parallel-ruled scale back of the pointer, so that its image will appear reflected on the surface of the mercury. The slightest contact of the pointer with this surface will cause the lines of the image to become distorted, and thus a very delicate adjustment of the instrument is possible.

Microbes in Humid Air.—According to the researches of Messrs. Trillat and Fouassier, published by the Académie des Sciences, microbes suspended in the air act as centers of condensation, when the air is humid. The authors give evidence of the existence of microbian drops in the atmosphere and they have studied their properties. One very interesting result is that the sudden cooling of the atmosphere has the effect of transporting the microbes and localizing them in determinate regions. The cool surfaces attract them from a distance almost instantaneously, the smaller being transported farther. These new ideas throw light upon the genesis of certain epidemics, and may be useful in planning the distribution of inhabited places.

Destroying Locusts in Turkestan.—A remarkably successful campaign has recently been conducted by the Russian government against locusts in Turkestan, where formerly the inhabitants, for religious reasons, did hardly anything to check the ravages of these insects. Turkestan supplies almost half the cotton used in Russian mills, and raises other valuable crops. As recently as 1901, locusts caused an annual loss of over $2,000,000 in this region, and only primitive methods of dealing with them were in vogue. The loss has now been reduced to practically nothing. The methods employed by the Russians include: (1) preparation in summer and autumn of forecast maps, showing the position, area and density of the egg centers of each district; (2) treatment of the infested areas with Paris green, or, better, molassed sodium arsenite, as soon as the larvæ appear; (3) scorching by knapsack machines of larvæ in places not accessible to sprayers, devoid of vegetation, or far from water-courses of sufficient capacity to keep the sprayers going; (4) capture of larvæ in pits or ditches. Breeding of parasites on a large scale for use in destroying locusts has not yet been attempted in Turkestan, though experiments in this direction are in progress.

Astronomy

Diurnal Variations in Latitude.—From observations made at Pino Torinese, by Boccardi, following the method of Struve, which was applied by utilizing four stars which could be obtained even in the day time, it appears that there are diurnal variations in latitude. The maxima and minima follow the movements of the moon, which seems to demonstrate its action.

The Proposed Reconstruction of the Mont Blanc Observatory.—The observatory which occupies the summit of Mont Blanc and which was constructed by Janssen is now entirely buried under ice, and it is desired to rebuild it. To this end, the Mont Blanc Observatory Society held a recent meeting at the Paris Institute, in order to consider the question. A report was read by M. Vallot, chief of the enterprise, and a commission was appointed for the purpose consisting of the three astronomers, Hamy, Puiseux and Stefanick, also M. Vallot, the eminent astronomer, and Dr. Bayeux, a physiologist well known for his numerous researches made upon Mont Blanc. These scientists propose to make an ascension to the summit of the mountain during this summer, in order to determine the conditions of re-installing the observatory. Mlle. Janssen, who is the daughter of the deceased scientist and who is continuing her father's work, was present on this occasion, and also Prince Roland Bonaparte and many eminent scientists.

Radial Velocities of One Hundred Stars with Measured Parallaxes.—Messrs. W. S. Adams and Arnold Kohlschütter contribute a paper to the *Astrophysical Journal* relative to the radial velocity determinations during the past three years of stars fainter than magnitude 5.5 on the visual scale for which observations of parallax are available. The photographs were secured with the 60-inch reflector in conjunction with the Cassegrain spectrograph adapted for use with one prism, but for stars from 5.5 to 0.5 magnitude a camera lens of 102 centimeters focal length was used, while for stars fainter than 6.5 a lens of 46 centimeters focal length was employed. Briefly summarizing some of the conclusions derived from this excellent piece of research work, the first to be mentioned is the enormous radial velocities of a few of the stars observed. Thus two indicated velocities of —325 and —242 kilometers, the first of these being the highest recorded radial velocity among any of the stars. Four other stars exceeded 100 kilometers, and several between 75 and 100 kilometers. A notable fact is the great preponderance of large negative over large positive velocities, no less than 75 per cent of the large velocities being negative.

The Light of Stars.—The March number of *Le Radium* contains a paper by Dr. A. H. Pfund, of Johns Hopkins University, in which he describes some preliminary tests he has made of a new apparatus for measuring the light of a star. The work was done at the Allegheny Observatory, the Keeler 30-inch reflector being used. In the focus of the telescope, either of two small blackened disks which formed the junction of a thermo-circuit could be placed. The wires used for the thermo-element were alloys of bismuth and tin, and of antimony and bismuth, respectively. They were enclosed in an evacuated capsule closed at one end by a plate of fluorite and substituted for the eye-piece of the telescope. The thermo-current was measured by a moving-coil galvanometer. The sensitiveness of the arrangement was such that a candle at a distance of eight miles would give a deflection of one millimeter. The deflections obtained from celestial objects were: Vega, 7.5; Jupiter, 3.0; Altair, 2.0 millimeters. The author hopes, by using a more sensitive galvanometer and other materials for his thermo-elements, to increase the sensitiveness considerably, and in this way to open up a new field of astrophysical research.

The World's Large Telescopes.—In a recent number of the *Observatory*, Mr. H. P. Hollis gives a very interesting list of large refractors and reflectors, either under construction or already set up in observatories. The largest working objective is that of the Yerkes Observatory in Wisconsin, U. S. A. Of the refractors under construction, the following may be mentioned: a 32-inch for the Nicolaieff Observatory, Russia; a 26-inch for the Union Observatory, Johannesburg; three 24-inch for the following observatories: Argentine National Observatory, Cordoba, Chili National Observatory, Santiago, and the Detroit Observatory, Mich., U. S. A., and a 20-inch for the Chabot Observatory, Oakland, Cal. The Earl of Ross's 72-inch reflector holds the field for the largest reflector (metallic speculum), while Dr. Common's 60-inch (silver on glass), now at the Harvard Observatory, U. S. A., comes second. Of the reflectors under construction, two giants are in hand, namely, one of 100 inches for the Mount Wilson Solar Observatory, and one of 72 inches for the Dominion Observatory, Canada. Others under construction are a 40-inch for the Simeis Observatory, Crimea, and two of 30 inches, one for the Helwan Observatory, Egypt, and the other for Mr. D'Esterre's Observatory, Surrey, England. It is interesting to note that the number of instruments in each list is about the same, namely, 38 refractors and 40 reflectors.

Dugeil's watercycle.

Watercycle Races

A Curious Contest That Took Place at Enghien-les-Bains

The Schweitzer rolling hydropied.

A NOVEL series of races, of which we are able to give our readers some interesting pictures, was held on the afternoon of June 14th at Enghien-les-Bains, a suburb of Paris. These races were a contest between various forms of water-cycles on the little lake of the town. The meet was arranged by the Parisian newspaper *L'Auto* with the aid of the management of the springs and of the boat club of Enghien. They proved so great a success, some 20,000 spectators being present, that other meets are planned. Thirty of the thirty-eight machines entered for the races appeared on the day set. These machines were divided into seven classes: 1. Machines on floats with propellers under water; 2. machines on floats with aerial propellers; 3. boats with hand or foot-operated propellers under water; 4. boats driven by hand-operated aerial propellers; 5. miscellaneous machines with propellers under water; 6. miscellaneous machines with aerial propellers; 7. machines of various constructions.

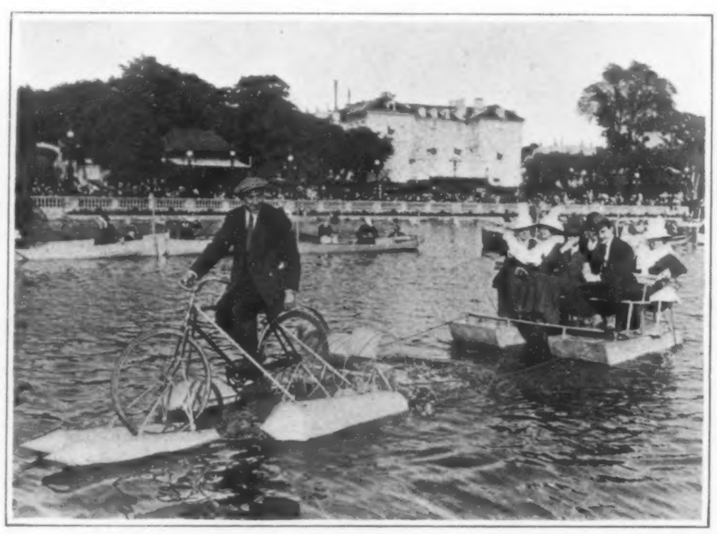
The programme of the races was as follows: At 2:30 P. M. a parade around the course, in which all contestants took

(*Concluded on page 66.*)

Tailliez, winner in the seventh class.

The Deguet apparatus.

The watercycle race which was held on the Lac d'Enghien, near Paris, on June 14th, 1914.



Deguet hauling a pleasure party.

The Schweitzer hydropied from the rear. It was driven by an air propeller.

The Louis apparatus, which was the winner in its class.

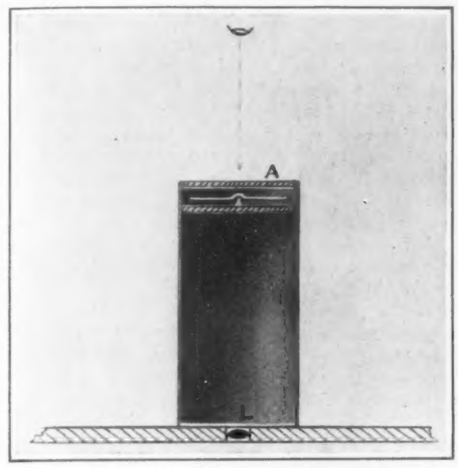


Fig. 1.—Sea focal plate for ascertaining momentary direction of translation.

Steering Air Craft at Sea

Some of the Difficulties of a Transatlantic Flight

By the Staff Correspondent of the Scientific American at Hammondsport

Photographs of Lieut. Porte's Instruments by F. J. Weyman.

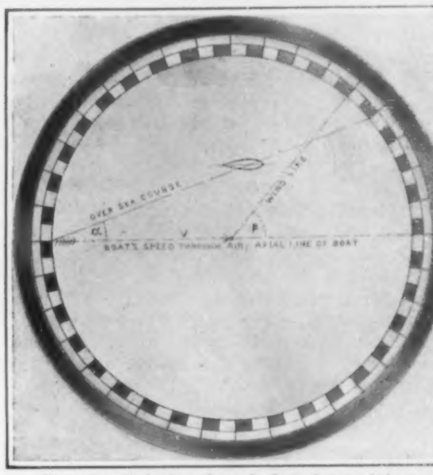


Fig. 2.—Velocity board for determining the momentary speed of the craft.

THE general art of piloting air craft, buoyant and unbuoyant, involves manifold tasks requiring manipulative skill, experience, and technical knowledge. The pilot, or his aid or crew, must keep the craft in structural and running adjustment; must maintain her poise and evenness of travel; must choose the most favorable air stream and altitude; must avoid perilous or impossible conditions; must navigate geographically, that is, determine the geographical position, and direct the course.

The geographical navigation of air craft without a map—the subject of the present inquiry—is of especial interest now, because of the approaching transatlantic flight. As applied to ocean flying it presents three questions: how to steer when only the sea is visible; when only the firmament is visible; when neither is visible. We may omit the case in which both sea and sky are clear, as this is but a combination of the first and second cases.

To be more specific we shall assume that the pilot is seated beside a qualified aviator, in a closed flying-boat with suitable windows, and provided with navigating instruments of his own choosing. He will want instruments for determining his boat's orientation, inclination, altitude, speed through air, momentary direction and speed over the water, hourly position on the globe, and hence the hourly course and speed, besides auxiliary instruments, such as a clock, hydrographic chart, weather instruments, astronomical and trigonometric tables, etc.

Determining the Direction of the Course.

The flying-boat's orientation referred to the earth's magnetic meridian, and thence, by chart or table, referred to the earth's meridian, can be determined by the ordinary mariner's compass. This can be read either by looking down upon its level face, or by looking horizontally into an inclined mirror or a prism. As the poise and motion of the boat can usually be kept quite steady the magnetic compass can be read truly to one half a degree. A specially light gyroscopic compass also may be used to indicate the true north independently of the earth's magnetism.

Measuring the Dip of a Machine.

The dip and tilt of the aeroplane can be measured with an inclinometer. A spirit level serves very well, especially for the more even conditions of the air at sea. When the billows or swells increase, the poise cannot, near the ocean surface, be maintained even, and hence can not be so accurately determined. An increase of altitude gives an evener poise, and will naturally be taken when the wind blows approximately with the vessel. In fair conditions the inclination can, with such a spirit level, be maintained and measured truly to a fraction of one degree, at least for a brief period of time. A short damped pendulum with a long pointer is also accurate, but less simple in structure.

Altitude Indicators.

The altitude of flight, when very small, can be measured with a plumb-line or an optical range finder; when great, with a barometer or barograph. When the sea is very smooth the plumb-line measurement may be made accurately to within less than a yard in one hundred feet; when quite rough the height cannot be measured accurately by any known method. The altitude may be satisfactorily determined with an aneroid barometer if the sea level pressure be first measured, and if the barometer readings be not vitiated by the rush of air past the barometer case. Means have been devised for obviating or minimizing errors from this source.[1]

Determining the Speed of the Craft.

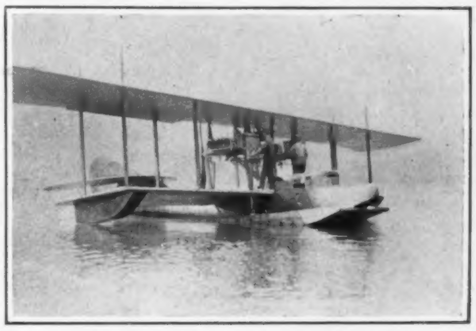
The speed of the boat through the air can be measured with anemometers of various types, as the screw, the revolving cup instrument, the wind-tube, the pressure plate, and numerous other kinds. All, however, must be placed and used with some skill. It is important that they measure the speed of the undisturbed air at some distance from the hull, unless, by special calibration, errors due to local modification of the general air speed can be obviated. If the shaft of the screw or cup anemometer have its outer end well away from the hull, and before the wings and propellers, while its inner end connects with a rotation counter, or common "speed indicator," or a very good tachometer, the number of turns per minute can be read truly to one per cent, and the speed of the undisturbed air flow past the craft can be measured with like precision. It is well to calibrate such instruments, in their working positions, by actual flight through air for a known distance, or by comparison with standardizing instruments. The wind-tube may be either a Venturi air tube calibrated by trial, or a coaxial wind-tube. The latter is sometimes, though erroneously, called a Pitot tube. It consists of an inner tube pointing its open end into the wind, an outer coaxial tube having a series of side holes around it, well back from the point, and a manometer and connecting hose for measuring the difference of pressure in the two tubes. From this pressure difference the air speed is calculated in terms of the air density, which must be known or found, say from the observed temperature, barometric pressure and humidity. If the density be neglected, an error of several per cent in the speed may be made; in fact, an error of about one per cent for each 5 deg. Fahr. change of temperature, and each three tenths of an inch change of the barometric height.

The pressure plate anemometer receives the impact of the air, and by the force of this duly indicated or recorded, shows the air speed in terms of the density. All such impact instruments, or "pressure anemometers," after collecting the air pressure, require that it be measured, then that the speed be determined from the density, either by calculation or by use of tables. For accurate use they are not ready instruments; for ready use they are less accurate than the "velocity anemometers," such as the screw or the rotating cups, etc. These, after calibration, require only that their angular velocity be taken, either with an instantaneous tachometer or with a speedometer and stop watch.

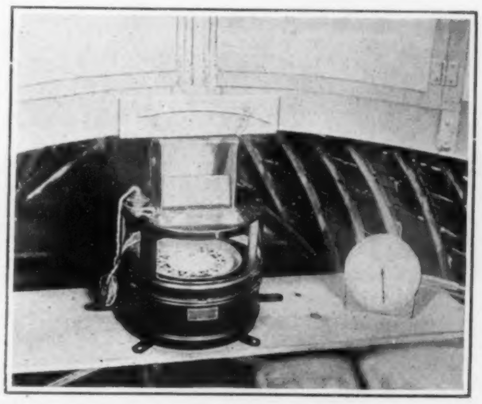
An aerial log line, consisting of a toy balloon and thread unwinding from a reel may be used, sailorwise, to measure the speed of the flying-boat, or to calibrate other anemometers. A Crocco anemometer also could be used to standardize others more convenient for practical navigation.

How the Direction of Translation is Ascertained.

The momentary geographical direction of translation of the craft over the ocean surface, regarded as stationary, may be determined by noticing the apparent line of transit of wavelets or floating objects past the boat, or across the field of an optical instrument therein, such as a camera or telescope. Such passing objects will appear to describe streaks or stripes along the focal plane, especially if the focal length of the objective and the height above the water be so chosen as to cause the images to cross the optical field quickly. If the objects have but slight speed across course, say one per cent of the boat's speed on her course, the resulting deviation of the stripes may be neglected. By sunlight the distinct objects on the ocean surface, more especially white caps, are usually numerous; by night luminous objects may be projected on to the water, preferably ahead of the aeroplane, and along its true course. Wooden balls coated with potassium will flash on striking the water. Sodium-tailed arrows or flaming torches, cast quickly upon the ocean face and remaining bright for a few seconds, may be used to sight back to, and thus indicate the course as compared with a compass needle. Under favorable conditions, the direction may thus be determined to about one degree. Whatever the visible object, if its image cross the plate quickly, say in one tenth of a second, it will appear as a stripe or streak all across, and may be



Preparing to test the side floats.



Fore part of "America's" cabin, showing compass, etc.

At left end of shelf is a bar magnet to correct deviation of needle due to iron and steel in airboat. Their compass was brought from England by Capt. C. Osborne, R.N. Note the hinged celluloid cabin windows above the instrument.

Stroboscope suggested for finding the speed of sea's image across a ground glass, to serve in estimating the oversea speed of the airboat.

[1] Zahm, Measurement of the True Pressure in a Moving Fluid, *Jour. Frank. Inst.*, 1913.

determined in direction by comparison with an adjustable line or lines of reference; if it cross slowly its position on entering and leaving the field may be noticed, thus giving the direction approximately.

Practically a lens may be inserted in the bottom of the hull and bring the sea's image to focus on a level ground glass or celluloid plate above it, or on a vertical or oblique plate if an oblique mirror be inserted between the lens and the image plate. Reference lines and a graduated arc on the plate may serve to measure the direction of travel referred to the boat's axis or the needle of a compass. The compass needle can be mounted just under the focal plate, if this be level, or reflected upon it if oblique or vertical.

For example, in Fig. 1 the lens L may bring the sea face to focus on the frosted plate A, preferably turnable in its plane and circularly graduated, while the compass needle is supported just beneath on a transparent plate. Again, the light from the same lens may be reflected by a mirror to focus on a vertical plate, while another lens may bring a compass needle to focus on the same vertical plate, by reflection from a transparent mirror placed before the other one.

The Speed at Any Given Moment.

The momentary speed of the flying-boat over the water may be determined in many ways. If her altitude be unknown, or disregarded, her speed over the water, and incidentally the wind speed, may be found as shown in Fig. 2. The speed V of the boat through air and her inclination a to her over-sea course are read; then she is turned into the wind line, or so that wavelets seem to move fore and aft, and the angle β of her turn is noted on the compass. From these three observations a triangle is determined giving the over-water speed of the boat, and incidentally the true wind speed. To simplify the process, transparent millimeter scales pivoted at the ends of V in the diagram can be set at the angles $a\,\beta$, and read at their crossing to give, in terms of V, the over-water speed of wind and boat. Thus if V be 100 millimeters, and 40 be read on the wind scale at the crossing, the wind speed is 40 per cent of the boat's observed speed through air. The scales can be read truly to less than one per cent; the speed V to one per cent, more or less; the angles $a\,\beta$, to about one degree. Hence the over-sea velocities of boat and wind can be determined to a corresponding degree of accuracy. The graduated disk and pivoted scales constitute in fact a mechanical device for solving any case of plane triangles, without the aid of trigonometry.

If the boat's altitude be known, her over-water speed may be found from the speed of the ocean's image moving across the field in an optical instrument, say a camera or telescope, or the sea focal plate just described, which, with the keel lens, is the equivalent of a camera. If this plate be large, and the altitude of flight be considerable, the period of transit of the image of a well-defined sea object can be taken with a stop-watch truly to one or two per cent. On a horizontal image plate the image speed is constant if the over-sea speed be constant. Hence the speed of travel of the image, multiplied by the ratio of the distances respectively from lens to sea and from lens to plate, gives the boat's over-sea speed. This ratio may be made some easy multiplier, say 100, by suitably adjusting those two lens distances. If the angular displacement through 45 degrees be taken with a rotating telescope or camera, and timed with a stop-watch, the over-sea velocity equals the boat's altitude divided by the observed time.

If, however, the sea's image crosses the plate or field of view too quickly, its speed cannot be found by a stop-watch. In this case two optical methods are available to find the over-sea speed of the boat; either halting the image, or diverting its course. To halt the image, it may be viewed either through a stroboscope or in a mirror rotating backward or in a like rotating telescope; to divert the image, the said rotation may occur perpendicularly to the path of the image, so that its lateral speed may be proportional to its direct speed, thus making the image travel at an angle to its natural course across the plate. The speed of telescope rotation, or half the speed of mirror rotation, that causes either halting of the image or diversion through 45 degrees, has only to be multiplied by the altitude of the boat to give the over-sea speed.

If the ocean face be too thickly fogged, the foregoing methods are unavailable to determine the over-water speed of either the boat or the wind. In this case, by flying moderately low, a light log line can be dropped into the sea and paid out while trailing due fore and aft of the boat temporarily turned into the wind line.[2] Thus observations of the log line and compass give the boat's over-sea velocity in the line of the wind. From this and the observed speed through air, the navigator, by using the velocity board, shown in Fig. 2, can immediately turn the boat to her desired course, and read off her over-sea speed along this course, palled though it be in fog or darkness. Also from the tracings of a pressure plate anemograph, which shows greater pulsations of speed in the wind line than when traveling across wind, and proportionately greater pulsations as the wind increases, it is claimed that the speed and direction of the wind can be judged even in the dark. But this claim is mentioned more for its novelty than for its validity.

Finding the Hourly Speed and Course.

The hourly speed and course can be found by astronomical means familiar to the marine navigator. The pilot can, with his watch and sextant, read respectively the time of day and the altitude of two heavenly bodies, say the pole star and another one, and from these data, by aid of his astronomical tables, he can determine his geographic position, i. e., his latitude and longitude. The change of position from hour to hour determines his course and hourly speed.

In practice several devices are available for finding the altitude or the zenith distance of a heavenly body. If the sea be clear the sextant's telescope, held freely in hand, is pointed straight at the horizon, while the angular distance of the heavenly body is measured with the sextant index. Ordinary swaying of the craft will not thwart this. In case the flight be moderately high, a correction can be made for the consequent depression of the horizon; if very high, the horizon blurs or disappears. With a clear horizon, an expert navigator can, it is claimed, thus locate his position on the globe truly to one mile or one minute of arc.

Another device is to use an artificial horizon. Astronomers measure the angle between the star and its image reflected from the surface of still mercury, and divide by two to get the true altitude. This method is available on land at any elevation and without clearness of horizon. To apply it in an air craft the mercury would have to be supported so as to remain level and smooth. In lieu of mercury a rigid plane reflector kept horizontal may be used, say a polished plate floating on a liquid, or supported on gimbals. Also a polished plate fixed to the aeroplane frame and kept level for the moment by the aviator, who can usually choose a favorable atmosphere several times a day, and hold his craft level to within less than one degree by means of the controls and inclinometers.[3] If the image of the star sway to and fro a degree or so during this leveling of the craft, the navigator can take the mean position, as is done in scores of laboratory instruments. Greater accuracy, however, is claimed for the sextant and plumb-line. By this combination experienced seamen claim to be able to locate their position truly to three miles, or three minutes of arc.

A third device is to focus the sky on a graduated chart kept horizontal and having its center vertically under the lens, fixed say in the top of the cabin. During the moment that the aviator holds the craft level, the zenith star or point of the sky can be focused on the center of the chart, and the other stars will have their images at distances from the chart center or zenith image, which are measurable on the chart itself by suitable graduations. The chart can be either plane or spherical, say concave upward like a dish, and the graduations for zenith distance can be made accordingly. If the center of the plane or concave chart be called the pole, lines radiating from it mark the longitude referred to it; circles about the pole space off the latitude. The positions of any two stars on this chart, preferably at some distance from the zenith, enable the navigator, by use of his watch and tables, to determine his true geographical position. The sea image plate already described, if suitably enlarged, may serve for the plane sky chart here considered, provided the sky lens be chosen of the right focal length. To obviate the need of holding the aeroplane level, the chart and lens can be rigidly mounted on a frame supported so as to maintain their proper poise automatically, or steadied by the observer with spirit levels. Instead of reading the star's position on the chart it may be recorded on a sensitive photographic plate or film graduated by photography or otherwise. The altitude of the sun and moon can be taken instantaneously. The star's record may require a large lens and considerable exposure; but there is little objection to a long exposure if the craft be kept from turning, or if the shutter be closed during undue oscillations, provided allowance be made for the drift of the image due to the earth's rotation. Thus, during a minute's exposure the star and its image travel one quarter of a degree due to the earth's rotation, and about 1/69 of a degree due to the boat's over-sea speed, if this be one statute mile per minute. The images of several bright stars can also be marked on the chart with a pencil, so that their zenith distance can be read at leisure. If, for example, the focal length of the sky lens be 57 inches or centimeters, the degree measured on a concave chart is one inch or one centimeter; so that if the chart be held level to a fraction of one degree, the zenith distance of the star can easily be read to a fraction of one degree.

In case the sky be long obscured, the pilot may compute his position from his continuous record of speed and direction since last taking his position with the sextant. An excellent method, if applied without excessive weight, would be to use two gyroscopic compasses inclined to one another, say one set parallel, the other perpendicular, to the earth's axis; the first indicating the true north and the latitude, the second indicating the longitude. The pilot, plotting his course from frequent readings of this apparatus, would have a good indication of his average momentary progress over sea, and thence could correct his steering, or find the average wind velocity by use of the velocity board already explained. The ordinary gyrostatic compass is graduated to single degrees and may be read to about one quarter of a degree, or 15 nautical miles. Such a check on the drifting of air craft at sea would, in the present state of the art, be very satisfactory, and especially in fog and darkness. Determinations of position by wireless, as practised in Germany, or by report from passing ships, may be disregarded here.

Unaided observation of the waves enables an experienced navigator to judge the speed and course of the wind to a degree of accuracy not despised by sailors. The well-known Beaufort scale of wind speeds is based on this principle. It is a primitive way of estimating the wind velocity, but may, when the wind is light, enable the air navigator to steer without greatly increased length of course. A good sailor can, by inspection of the waves, judge the direction of the wind truly to within ten degrees, and its speed truly to 30 per cent. With equal or greater accuracy the skilled aviator can judge his over-sea direction and speed by mere inspection of the passing water near at hand.

The effect of errors in steering may be minimized by timely correction. If in sailing from A for B one really follows the course $A\,C$, making a small angle with the true course, say 5 to 10 degrees, no serious increase of course ensues, provided the departure be corrected well before B is approached. The hypotenuse of a plane triangle is half of one per cent longer than the base, if the angle between them is 5 degrees; 1½ per cent longer if the angle be 10 degrees. The main objection to such errors of direction is the missing of the port, or place aimed at, rather than the lengthening of the course. But if the geographical position can be determined truly, the navigator can always correct his defects of steering, and finally arrive near his goal. One degree error on a great circle is a linear error of 60 nautical miles, or about 69 land miles. Hence, if the navigator is sailing for a large conspicuous coast, he need not miss it because of an error even so great as one degree in taking the stars, nor very materially lengthen his course by an error of 5 to 10 degrees in steering, more especially if he has merely to reach the coast and not any specified point thereon.

As we have seen, the errors in direction when steering with the compass, aided by instruments for estimation of wind velocity, can, under fair conditions, be kept well under 5 or 10 degrees. Suppose, however, that the wind be judged by the eye alone; say the speed truly to 30 per cent, the direction truly to 10 per cent; what then is the likely range of error in steering by compass an air craft having a natural speed of 60 miles an hour? As a particular case, suppose a wind of 20 miles an hour blow squarely across her desired course. The pilot, misjudging the wind speed by 30 per cent, will think it 6 miles faster or slower than it really is. When he has pointed his course to the best of his ability he will be advancing toward his goal at 60 miles an hour and drifting sidewise 6 miles an hour. The error in steering is thus an angle whose tangent is one tenth or an angle of 5¾ degrees. The lengthening of course due to this error is about one half of one per cent, and the drift off course about 60 miles in a voyage of 600 miles. If the whole direct course be 1,200 miles, and no correction for drift be made during the first half of the voyage, this half is lengthened out by the error to the extent of about half a per cent of 600 miles, or about three miles.

From the foregoing discussion of the navigating devices and of the consequences of error in steering, it appears that no grave evil is to be expected from steering over any length of sea course terminating on a liberal coast line, say of 2 degrees, or 120 nautical miles, provided that a powerful and long sustained storm be not encountered. For example, in the proposed flight of Lieut. Porte and Mr. Hallet from Newfoundland to the Azores, an habitual error of half a point, or 5½ degrees, corrected by the heavens from time to time, would entail an increase of course of about six miles, or an increased consumption of fuel of 6 pounds. This is small compared with the increase of load that may be had from slight improvements of design. For example, an increase of one per cent in the propeller thrust means an increase of 50 pounds in the useful load.

Lieut. Porte's instruments and methods of navigating

[2] If the over-water course be oblique to the wind line, the log line tends to trail fore and aft, due to the air rush past the boat. A fine wire trailing from a low flying-boat, with good water drag, tends to indicate the true course over water even when flying obliquely to the wind.

[3] It is still an open question as to how nearly dead level an aeroplane can be held for a brief time, say half a minute, in smooth air.

have not all been made public, if indeed they have all been fully and finally decided upon. He has, however, announced that he will have a sextant, a mariner's magnetic compass, watches for solar and sidereal time, an anemometer for measuring his speed through air, and possibly an instrument for giving his instantaneous or momentary speed and direction over water. The latter, commonly called a "drift instrument," is of considerable importance, as it enables him to allow for the wind in laying his course. He expects also to secure from passing ships information as to their momentary distance from his proper course, to be conveyed by special flag signals according to a prearranged code. In case of need, carrier pigeons and rockets will be used to convey information, or to call for assistance.

Further Changes in the "America's" Bottom

By Our Staff Correspondent at Hammondsport

WHEN Mr. Curtiss, by use of the planing fins devised by himself and Dr. Zahm, and described in the SCIENTIFIC AMERICAN of July 18th, had made the "America" leap bodily out of the water at less than 20 miles an hour, he suddenly halted that promising series of experiments. He did not, as originally planned, proceed to make the angles of the planing fins adjustable, so as to regulate at will the amount of lift; but, yielding to the urgence of Lieut. Porte, he reverted to the pontoons, so as to secure greater flotation and possibly a stancher construction. The lieutenant was positive that large flat floats, lashed to either side the "America's" hull, must enable her to plane and rise promptly from the water with the desired 5,000 pounds total weight. From the data so obtained, the hull could be remodeled quickly to a compact, efficient form, and sent without further delay to Newfoundland.

Accordingly the pontoons of the Langley machine, which measure each 10 feet long by 3 feet wide by 10 inches deep, were lashed to either side the bow, flush with the bottom. But, though they had enabled the "America" to carry her largest load previously, when under the middle of the lower plane, they now gave much less lift, owing perhaps to the disturbed state of the water about the bow. They were at once replaced by larger pontoons, each measuring 13 feet long by 3 feet wide by 16 inches deep, lashed firmly to either side the bow and nearly flush with its outer bottom edge, being a trifle higher. The craft, so equipped, failed to rise with two men at first; then, after careful adjustment and trial, she planed well over the water, but would not lift so well as she had previously done with the smaller Langley floats under the middle of the lower plane. The big pontoons beside the bow were then discarded as being neither efficient nor promising.

In the meantime Mr. Curtiss, with little faith in the big pontoons, was studying and planning new varieties of planing boards. The most promising of these was an inverted V bottom fixed under the boat of the "America," and measuring about 16 feet fore and aft by 7½ feet wide between its parallel bottom edges. The sides of this inverted V bottom were steep under the prow, but practically horizontal under the step at the rear. This arrangement of the planing surface is known as the sea sled, and has the merit of gathering the bow wave underneath it and riding on the same, while throwing little water off at the sides. When properly rounded upward at the front it further tends to damp the pitching of the craft. Trials made with the sea-sled proved so encouraging that the hull of the "America" will be remodeled to the sea-sled bottom. Then the trials at Hammondsport will be virtually finished.

In the first trial of the sea sled bottom the airboat rose quickly to the water surface and planed neatly, with its load of three men, Mr. Curtiss, Lieut. Porte, and Mr. Hallet. When skimming on her heel, or step, she showed a tendency to nose forward and scoop water, a tendency not difficult to correct. The men returned smiling, and with evident confidence in the future of this type of planing board.

Photo. by Benner.

Lieut. Porte and Mr. Hallet in the "America's" bow.

Here the planing fins may be seen which were tested at an earlier period. Subsequently, side floats attached to the hull were used. These, while more successful, did not give the desired result.

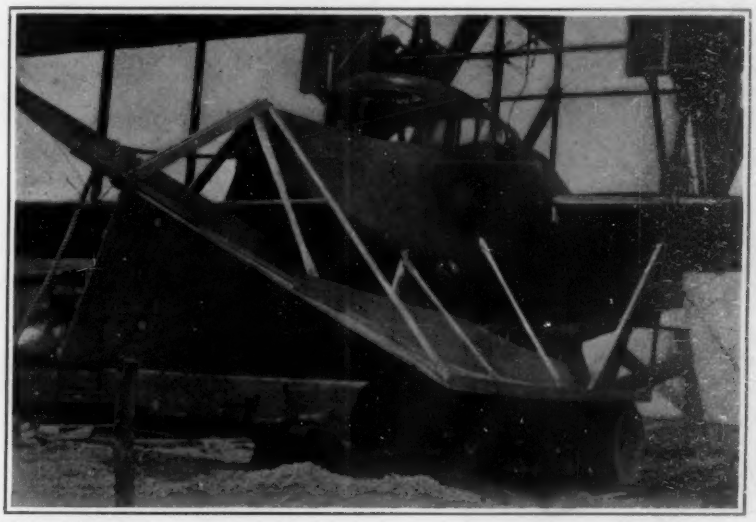


Photo. by F. Weyman.

Sea-sled bottom under the "America," to make her skim the water with full load.

The lower front corners were curved upward to prevent scooping water when the boat dipped or met a billow. The truck supported the craft softly till she was launched in sufficient depth of water.

Phosphorescent Air Craft

NIGHT flying is now indulged in so systematically by military officers that the European governments have cast about for some means of guiding airmen. As might be expected, the Germans were the first to attack the problem and to offer a practical solution. Many of the more important military flying grounds of the German Empire are now provided with aerial lighthouses —beacons which are analogous in function to the lights which guide the mariner when he nears land. Each German beacon has its characteristic flash, so that the airman may know a particular lighthouse by its flash. The vision which Kipling presented in his "Night Mail" —a vision of a planet studded with queer structures which send out intermittent flashes or sweep the sky with long, finger-like searchlights—is in a measure realized only ten years after aviation became a reality.

The German system of employing lighthouses and searchlights, efficient though it is, is undeniably expensive. It involves the construction of suitable towers, the installation of lighting apparatus, and the maintenance of a staff of lighthouse keepers. In a most interesting lecture which was recently delivered before the Aeronautical Society of New York, Mr. William J. Hammer expressed the opinion that phosphorescent paint might be used with great advantage for the same purpose.

Now ordinary phosphorescent paints, consisting chiefly of calcium sulphide contained in various vehicles, such as linseed oil, are not well adapted for the purpose. They give a ghastly greenish blue. There must be some means of varying the color of the luminous paint which is employed—a means which it has remained for Mr. Hammer to discover.

To be sure, it is possible to number machines or to apply even the ordinary calcium sulphide luminous paint in characteristic patterns. But a machine thus adorned would have to approach very closely indeed before it could be recognized. What is obviously wanted is a method of making phosphorus paint in different colors.

Before we can explain how Mr. Hammer has succeeded in attaining this result, we must clearly keep in mind the distinction between phosphorescence and fluorescence. A phosphorescent substance is one which continues to glow in the dark after it has been stimulated by sunlight or electric light; a fluorescent material, such for example as resorcin blue, responds to stimulation only so long as it is within the influence of excitation, and becomes inactive as soon as the source of excitation is removed.

Mr. Hammer has found that by combining phosphorescent material with fluorescent liquids of various kinds, he can obtain a large variety of luminous paints. The fluorescent material can be dissolved in alcohol or ammonia and then thoroughly mixed in the phosphorescent material, so that each particle of the calcium sulphide is coated and impregnated with the fluorescent material. When the resultant mixture is stimulated by the mercury arc or other means, it glows with a most brilliant color, depending upon the fluorescent material used. Since many of the coal tar dyes have a marked fluorescent effect, it is possible to obtain a range of color which is indeed very wide.

The results are not always, and, in fact, not generally like the colors either of the fluorescent material or of the phosphorescent substance which is mixed with it, and which forms the main basis of the luminescent when excited. Hence the art which Mr. Hammer has discovered, resembles in its practical application more the art of china painting, in which the artist uses colors of most incongruous appearance, which are entirely changed by the process of firing.

Of all the results which Mr. Hammer obtained, perhaps his white phosphorescent paint is most remarkable. Here we have a glow which is all but free from the usual greenish blue that is so characteristic of phosphorescence and that is usually so weirdly unpleasant. This phosphorescent paint is obtained by combining a mixture of phosphorescent zinc and calcium sulphides with alcohol, or with a trace of tincture of stramonium or uranin in alcohol and making a paint with oil.

The possibilities of Mr. Hammer's discovery are wider than may at first be imagined. Not only may aeroplanes and airships be painted entirely or striped in parts with luminous paint of various colors, but hangars, tents, and buildings may be coated in a distinctive way. Moreover, the paint may be applied not only to the structures of an aerodrome, but to buildings along the route between two points. Indeed, there would be no difficulty in mapping a very clear track for an aviator, between two cities—a track which it would not be hard to follow if the aviator is low enough.

The practical applications of the discovery are, of course, far wider. The theatrical effects which can be obtained are at once obvious. The paint may be applied to draperies or to solid objects—indeed to any surface. Moreover, pictures may even be painted with these luminous paints—pictures which under excitation would possess an intensity most remarkable.

Did Prof. S. P. Langley Invent the First Practical Flying Machine?

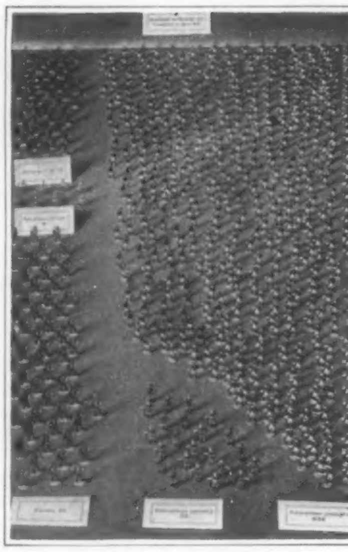
By C. Dienstbach

THERE seems to be good reason for determining the real merits of Prof. S. P. Langley's ill-fated man-carrying aeroplane of 1903 from the viewpoint of the most recent progress in flying machines, because the recent criticism by Mr. Griffith Brewer, in the face of the demonstration at Hammondsport, shows glaringly how the subconscious effect of ancient press derision is still liable to impair the memory of a great pioneer.

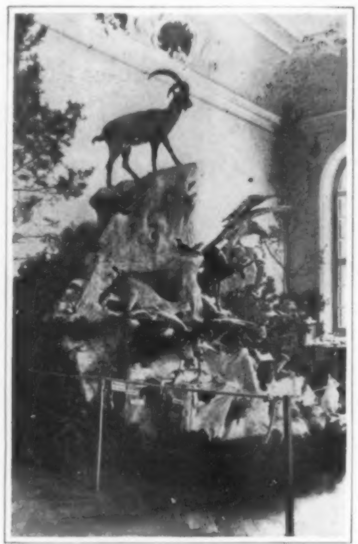
The only difficulty experienced at Hammondsport was in the machine's ability to lift the weight and overcome the air resistance of the pontoons and their framing, added for starting from the water. The power of the motor constructed by Mr. Manly has been established by tests of the same irreproachable scientific accuracy that distinguished the mechanical part of Langley's work from previous experiments with flying machines to be exactly 54 brake-horse-power—far in excess of the famous so-called 50 horse-power Gnôme motor, which still easily lifts two men. Langley's propellers were tested equally well. As the total area of the wings was far more ample than in modern machines, a rather low carrying efficiency is obtained, which can be attributed only to Langley's plan of depending for longitudinal stability partly on wings in tandem. Of these wings, the rear pair are deliberately dis-

(Concluded on page 65.)

Modern Alpine popular costume.



Representation of the frequency of ascents of the Totenkirchi.



Alpine fauna group, including the chamois, ibex, and golden eagle.

Bridegroom's Alpine costume in olden times.

An Alpine Museum

By Dr. Alfred Gradenwitz

THE Alpine Museum founded at Munich by the German-Austrian Alpine Society, is intended to illustrate the relations of man to the mountain world at various times and in various forms, in the structure of mountains and glaciers, and in their flora and fauna. The technical and intellectual resources of mountain travel and mountain climbing are to be recorded and preserved for future times in their historical development, as far as the remains of the past will permit.

The museum is housed in one of the most beautiful parts of Munich on an island of the river Isar, close to Maximilanstrasse, and the new home of the German Museum, in an attractive rococo castle which, by its internal appointments, would not seem to be especially suitable for museum purposes. This drawback is, however, more than outweighed by the fact that the building is surrounded by an extensive garden which is not only adapted for mineralogical and botanical purposes, and for the installation of an open-air museum, but which affords ample space for an eventual extension of the museum and its central library.

On entering the garden, seventeen boulders of about 40 by 60 centimeters remind the visitor of the mountain world. It is intended gradually to represent by about 100 blocks of this kind all the more important rock formations of the Alps, with their characters and peculiarities, thus bringing them home to lay people much more forcibly than by the small samples generally contained in mineral collections. A special point is made of choosing specimens as characteristic as possible, which, at the same time, will even show other phenomena of geological interest such as decay, the effect of mountain pressure, fissure healing, petrifactions, etc. The samples so far installed illustrate the main types of rock of the schistose cover on the north side of the Central Alps, specimens of the most varied crystalline rocks which, though being in great part of a sedimentary origin, have been so transformed by subsequent processes (volcanic phenomena and those due to mountain pressure) that their geological age in the absence of petrifactions cannot be readily recognized.

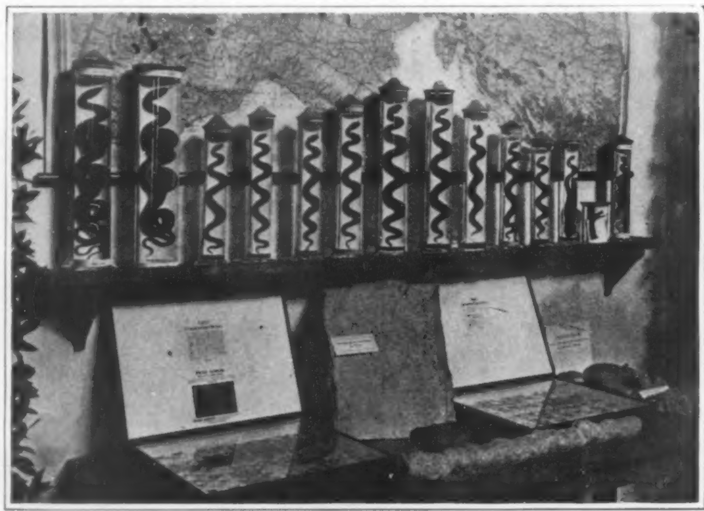


Exhibit of Alpine snakes and butterflies.

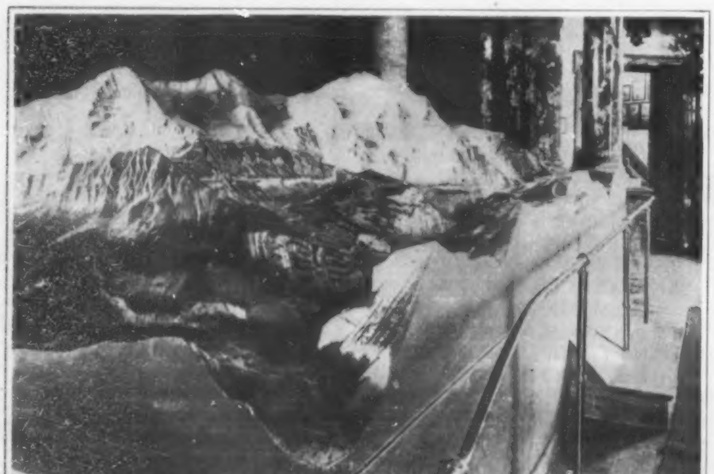
One of the pictures decorating the walls. The crater of Cotopaxi, Ecuador.

On entering the vestibule, we are met by two life-size statues created by the sculptor, E. Geiger, a "Mountain Climber" and a "Navigator," which like friendly demons guard the entrance to the large hall. The vestibule is further decorated with four oil paintings of Alpine scenery.

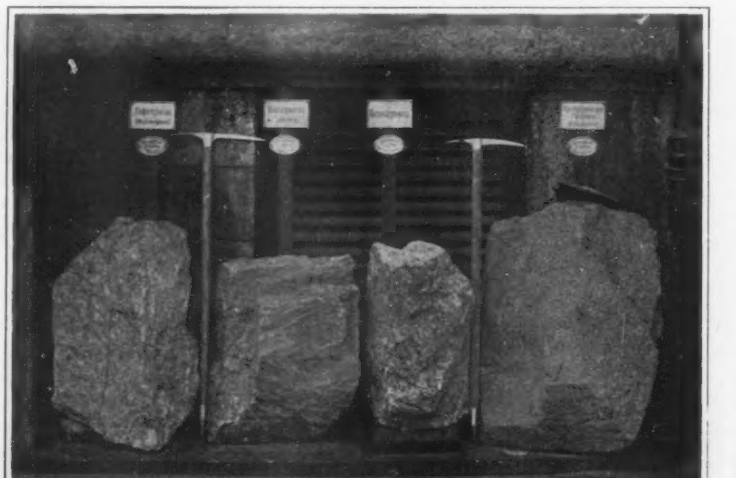
The center of the large hall is occupied by a Jungfrau relief made by X. Imfeld of Zurich on a scale of 1 in 2,500, which, apart from the Glockner relief, is the only one of similar dimensions. The remarkable perfection of the relief from a technical point of view, the beauty and artistic effects of its renderings of mountains and glaciers, cannot be adequately depicted in words. An idea can, however, be formed of the laborious work of many years required to perfect this relief when considering that it comprises as many as 600,000 minute wire brushes plastered into the background, which imitate the woods and wonderfully enhance the plastic effects of the whole.

In the department of Alpine Mining, some instances are given of the useful minerals found in the Alps and exploited in mines. Showing as they do, side by side with ores, samples of mineral admixtures, these collections at the same time have a real scientific interest.

(Concluded on page 66.)



Relief model of the Jungfrau.



Boulders constituting part of the mineral collection.

Crossing "Greenland's Icy Mountains"

The Three Recent Expeditions Across the Great Ice-Cap

By Charles Fitzhugh Talman

Illustrated With Photographs Taken During the Danish Expedition Under Capt. Koch

THE real topography of the world's largest island is an eternal mystery. A narrow fringe of land along the coast lies bare in the brief summer, while on the slopes of the ice plateau, but not far inland, a few isolated peaks (*nunataks*) jut up through the ice and form little oases in the frozen desert, giving a foothold to a scanty flora and fauna. Aside from these insignificant patches of real *terra firma*, the whole vast land lies buried beneath a dreary waste of snow-covered ice, difficult of access on account of the deeply crevassed glaciers by which it is bordered, but not especially difficult to traverse, as Arctic wildernesses go, when once it has been fairly entered. Add to these features an intensity of cold rivaling that of the celebrated "cold pole" of northern Siberia; violent blizzards blowing down the slopes toward the coast; and in the interior, where the weather is normally calm, the rarefied atmosphere of great altitudes (ranging up to nearly 10,000 feet above sea-level) causing explorers to suffer all the distressing symptoms of mountain sickness. Such are "Greenland's icy mountains."

The first extensive journeys over the inland ice were made by Nordenskjöld and Jensen, in the '70's and '80's of the last century, and finally in 1888 Nansen accomplished the first complete crossing of the island from coast to coast. He traveled from east to west across the tapering southern end of the island, a distance of 350 miles, after a series of delays and mishaps had prevented him from taking a longer and more northerly route. In 1892 a far more difficult journey across the northernmost part of the ice was made by Peary. Again in 1895 Peary crossed, not far from his earlier route, and returned to his starting point on the northwest coast, a total sledge journey of 1,300 miles. The dangers and hardships with which this expedition was beset make it one of the most brilliant achievements in the whole history of Arctic travel.

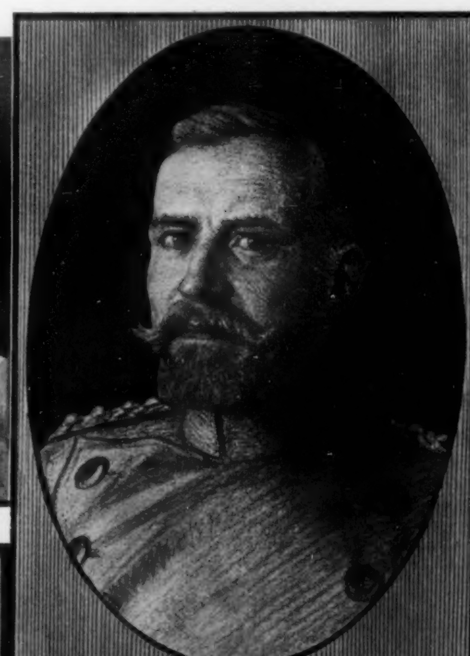
Typical Greenland hummocks.

How the horses were stabled in the ice.

De Quervain's Expedition of 1912.

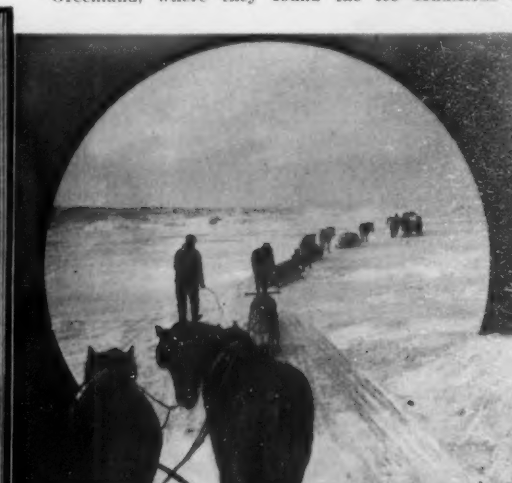
After a lapse of seventeen years the exploration of the Greenland ice was again undertaken, about the same time, by three expeditions. A Swiss party, under Dr. Alfred de Quervain, landed at Holstenborg, on the southwest coast, April 27th, 1912. The programme of this expedition was twofold, comprising important scientific investigations on the west coast, by Drs. Mercanton, Jost, and Stolberg, and the crossing of the ice-cap by Drs. de Quervain and Hoessli, and Messrs. Fick and Gaule. The western party made numerous measurements and observations of glaciers. Two of its members, Jost and Stolberg, spent the winter of 1912-13 at the Danish scientific station on Disko Island, where pilot-balloons were sent up at frequent intervals to determine the drift of the atmosphere at various levels; one of these balloons reached the remarkable altitude of 24.2 miles. Contrary to expectation, no definite circumpolar "whirl" was found by these observations. Dr. de Quervain's party started from the west coast June 10th, and gained the inland ice June 20th. With three sledges and thirty dogs the explorers took a straight course in a southeasterly direction. Early in the journey they had the misfortune to break through the thin ice coating of a large lake, but with no worse results than a cold bath. After a march of 435 miles they arrived safely at Angmagsalik, on the east coast, August 1st. The crest of the ice was reached two thirds of the way across, with an altitude of 8,200 feet, about 650 feet less than the altitude attained by Nansen in his crossing farther to the south. At each camping place on the journey the contours of the surrounding ice were measured in all directions with the theodolite, so that the total results constitute the survey of a zone a score of miles or more in diameter, extending across the ice-cap. Near the end of the journey a new mountain range was discovered north of the route, and quite near the east coast. The explorers named this region "Switzerland," and its highest peak (9,000 feet) Mount Forel. An entertaining popular account of this expedition has recently been published by the leader ("Quer durchs Grönlandeis," München, 1914) while the scientific results are to appear as a volume of the *Mémoires de la Société Helvétique des Sciences Naturelles*.

Capt. J. P. Koch.
After a pencil drawing by Achton Friis.

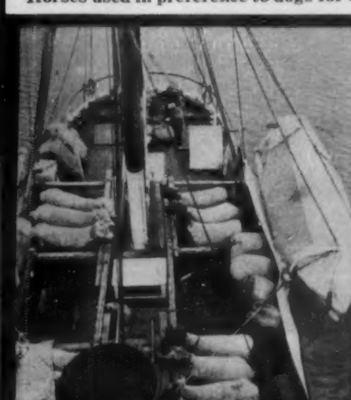


Crevasse in the inland ice near the point at which ascent was made.

Early the same summer a Danish explorer, Capt. Koch, undertook the formidable task of crossing Greenland at its widest part. His companions were the well-known German meteorologist, Dr. Alfred Wegener, of the University of Marburg; a Danish sailor, Larsen; and an Icelandic peasant, Vigfus. After making a practice journey across difficult mountainous country in Iceland, the party proceeded to the northeast coast of Greenland, where they found the ice conditions so favorable that they were able to land without difficulty in the neighborhood of Cape Bismarck on July 24th. The plan of the expedition was to winter in Queen Louise Land, or at least somewhere on the border of the inland ice, which in this part of Greenland is at a considerable distance from the coast. In order to reach winter quarters with some twenty tons of stores and equipment, over a rocky country free from snow and ice, Iceland ponies had been chosen for transport in place of dogs. This choice seems to have been inevitable under the circumstances, though dogs would undoubtedly have been more serviceable in the subsequent journey across the ice-cap; Koch's experience confirming that of Scott and Shackleton as to the unsuitability of horses for polar travel.



Horses used in preference to dogs for transportation.



Iceland horses on board; photographed from mast-head.

Great difficulty was experienced in finding a practicable route to the summit of the ice over a rugged and much-crevassed glacier front. While the ascent was in progress the explorers had the rare, and in this case very dangerous, experience of witnessing the

calving of a glacier at close range, and part of their stores were overwhelmed by the falling masses of ice. So much time was spent in scaling the glacier that the plan of wintering in Queen Louise Land had to be abandoned; a house was accordingly built on the glacier. This was named "Borg." Here the winter was spent in scientific work.

Adventures of Capt. Koch and His Party.

On the 20th of April the little party began the 700-mile march across the ice to the west coast. Day after day furious blizzards had to be faced. At times the march was suspended in the hope that the force of the wind would abate, but the explorers at length realized that violent winds blowing down the ice slope from the interior toward the coast were a normal and permanent feature of the climate; and this has been the experience of the other Greenland expeditions. These winds are analogous in character and origin to the outblowing blizzards of Antarctica, which proved fatal to Capt. Scott, and added so much to the hardships of Dr. Mawson's sojourn in Adélie Land. At the crest of the ice-cap Capt. Koch's party found light, variable winds, with frequent fog. In descending the west slope they had the wind at their backs, and, by fitting sails to their sledges, were able to make very rapid progress. The last nunatak on the east side of the ice was passed May 6th, from which time until July 2nd no land was seen. The ponies suffered with snow-blindness and exhaustion, and most of them had to be killed long before the end of the journey. The last of them was shot just before pasture land was reached on the west coast, after the explorers had actually drawn it on a sledge for several days, in the hope of saving this good comrade's life.

The greatest elevation of the ice, about 9,900 feet, was found nearer the west than the east coast, which was the reverse of de Quervain's experience. The explorers suffered from sunburn by day and intense cold by night (minimum 21 deg. below zero, Fahr., in mid-summer).

On July 2nd the monotony of the journey over snow and ice was relieved by the sight of a nunatak, and 37 miles beyond this point the western edge of the ice was reached on July 4th. Shortly afterward the party succeeded in locating a small depot of provisions which had been laid for them two years previously. On reaching the ice-free littoral they had still to travel for 11 days, part of this time being spent in crossing the Lakse (Salmon) fiord and river in a boat improvised from their sledges and sleeping-bags. The little settlement of Pröven was reached July 15th, and the journey was over.

What the Koch Expedition Accomplished.

The scientific results of this expedition, a brief account of which has been published by Dr. Wegener in the *Zeitschrift der Gesellschaft für Erdkunde zu Berlin*, and which are to be presented in full in the Danish publication *Meddelelser om Grönland*, are undoubtedly among the most interesting ever achieved in a polar expedition. Only a few details can be mentioned here.

At winter quarters measurements of the temperature in the interior of the glacier to a depth of 79 feet were made by means of a shaft and bore-hole beneath the dwelling-house. Below the level at which the seasonal fluctuation of temperature ceased, a slight but regular increase of temperature with depth was found, analogous to that which occurs in the earth. On the inland ice the stratification of the snow was observed, as seen in the walls of the pits dug at each camping-place as stables for the ponies. Each layer represents a year's snowfall, and thus an approximate idea was obtained of the precipitation of the region over which the explorers traveled. Dr. Wegener secured a great number of microphotographs of snow and frost crystals, with simultaneous observations of temperature and humidity, serving to indicate the conditions under which the various forms occur. Numerous photographs were taken of mirage; also of the aurora borealis. Observation of sky-polarization made with the Savart polariscope.

An even more remarkable journey across Greenland was made by two Danes, Knud Rasmussen and Peter Freuchen, with two Eskimos, who started from a point near Cape York, on the northwest coast, April 6th, 1912, and crossed to the northeast corner of the island, visiting *en route* the ice-free region of Peary Land. This was reported by Peary to be a separate island, and is still so shown on nearly all charts, but is now known to be merely the northernmost part of the mainland. After extensive explorations, in the course of which they discovered traces of old camps indicating that the Eskimos had preceded the white man to this remote region, the explorers retraced their steps, reaching Cape York September 15th. This journey was unique in that the party carried no regular provisions, but lived, Eskimo-fashion, on the country. Thus unencumbered, they were able to march 30 miles a day with ease.

One outstanding result of the recent campaign of explorations in Greenland is that former ideas regarding the general contour of the ice-cap have been considerably modified. Instead of being a more or less symmetrical dome, with the greatest elevation at the center, it is now known to have at least two principal summits; one a little north of latitude 65, the other at about latitude 74. A journey across the island in a north-south direction—a more difficult undertaking than any of those described above—would doubtless throw much further light upon the true form of the great ice plateau under which Greenland lies forever buried from the eye of man.

At the border of the inland ice.

"Borg," the winter house of the expedition.

Map of Greenland, showing routes of several expeditions.

Teaching the Use of Current Periodicals in Elementary Schools

WILLIAM E. GRADY, principal of Public School 64, of the Borough of Manhattan, New York city, has been trying to secure the co-operation of some of our best magazines and weeklies in inaugurating a new and a very necessary course in school curriculum. He feels that pupils are not trained to read intelligently various types of publications, such as newspapers and magazines, from which in later life they will have to glean the bulk of their knowledge. According to his plan, the different classes will discuss current magazines under the guidance of a teacher, which discussion will take the place of the ordinary formal lesson dealing with the so-called "masterpiece of literature." Mr. Grady's scheme is outlined in the following plan of work:

Point of View:

"A thoughtful criticism of our current literary teaching in the upper grades of our elementary schools, is to the effect that pupils are not trained to read intelligently various types of publications, such as newspapers and magazines, from which in later life they will have to glean a great part of their knowledge."

I. Material shall be stamped with school stamp and shall be filed and catalogued in a special room.

II. On request countersigned by principal or assistant, teachers of 6A, 6B, 7A, 7B, 8A, 8B group may borrow such material for purpose of actual instruction in their several subjects. Such material shall be returned to its room on same day.

III. Teachers using such material are requested tc form judgments as to its value and to discuss results with the principal.

IV. General topics and controlling ideas suggested for consideration in connection with said material are the following:

(1) Pupils should be led to appreciate that the reading of such material is a real test of mental ability in general and of reading ability in particular; that many of the facts in after life, whether such facts be cultural or technical, must be gleaned from such sources.

(2) Teacher's instruction shall subordinate mere facts to methods of sound thinking. To the extent that pupils display individual taste and judgment in the selection of articles for discussion, to the extent that they distinguish the relative importance not only of articles, but also of paragraphs and statements within the limits of said article, and to the extent that they can epitomize an article in a series of concise, well-knit sentences, the work will be distinctly educational, rather than the mere employment of a leisure moment.

(3) The organization of the magazine or periodical should be discussed in terms of the following:

(*a*) Title, company, cost.

(*b*) Aim and value in terms of range of topics, reputation of contributors, point of view of editorial articles, relationship of articles in monthly or weekly publications to the current events of each month as reported in the daily papers. For example, note the different aims of such magazines as *Collier's*, *Literary Digest*, SCIENTIFIC AMERICAN, *The Survey*, *St. Nicholas*, *Good Housekeeping*, *Ladies' Home Journal*, *Review of Reviews*, *Outing*, *The Outlook*, *The World's Work*, *Scribner's*, etc.

(*c*) Illustrations and cartoons.

(*d*) Quality and range of advertisements.

(4) Test value of work with pupils in terms of particular lesson units and also more generally in terms of:

(*a*) Reading habit as indicated by knowledge of current events.

(*b*) Desire to include good current topics as basis of oral or written composition.

(*c*) Critical judgments as to what magazines, weeklies, etc., and article therein, interest them most.

(*d*) Increased appreciation of design, drawing, and lettering.

(*e*) Occasional purchase of or subscription for material used in classroom discussions.

(*f*) Increased use of facilities offered by reading rooms in Tompkins Square Library, Christadora House, Cooper Union, etc.

(*g*) Organization of pupil groups on club plan to purchase publications to be circulated within the limits of the group.

V. If the literary material obtained through the courtesy of the various publishers be used by the departmental teachers of literature in every 3-minute or 4-minute lesson to supplement the study of the masterpiece designated in the course of study, the work will be distinctly more practical and cultural.

Moreover, the teachers of special subjects like geography ought to find it possible really to vitalize the subject matter of the text-books by the study of current happenings. The destructive action of spring floods in the Mississippi Valley or the heroic death of Scott in the white wastes of the Antarctic should provide the initial rather than the final steps of instruction in geography and history.

Cleaning Plaster Statuettes

A SIMPLE but effective method for removing the grime which plaster statues, etc., gather in the atmosphere of cities is suggested by *Les Annales*. A thick solution of starch, such as laundresses use, is made and the object is covered with it, care being taken to have it penetrate every crevice. The starch paste is then allowed to dry, whereupon it crumbles away, carrying with it the dirt on the surface of the plaster.

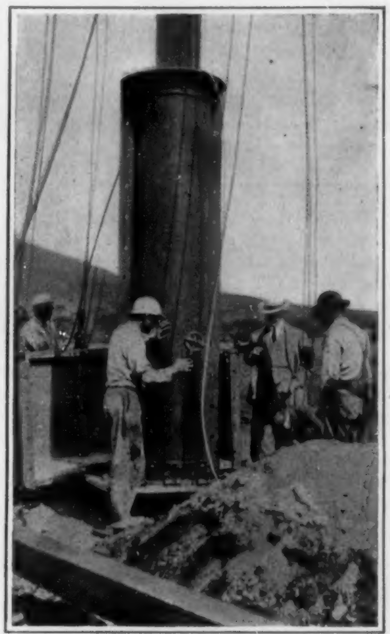
A Simple Method of Erecting Tall Wireless Masts

IN the construction of the chain of world-encircling wireless stations which are being erected by the Marconi Company, the importance of a thoroughly reliable yet simple aerial support was one of the first considerations. These photographs, made at the station at Hawaii, give a very good idea of how these masts are constructed.

A concrete base was first laid and a bed plate fastened to it. The mast came in split cylindrical sections about ten feet in length. The flat sections of these semi-cylinders were placed face to face, bolted to the bed plate, and the faces bolted together. Then a man cage was constructed and rigged to a system of blocks and tackles, so that it could be raised as the mast grew. The sections were "staggered," that is, one would be placed at right angles to the one preceding. Guys were attached as the work progressed. Towers as high as 450 feet were erected in the course of a few days.

Copyright by Worts.

Erecting a 450-foot mast.



First mast-section being set in place.

Treading on Time

VISITORS at a recently completed hotel in Worcester, Mass., are able literally to "tread time under foot."

In these days we are becoming accustomed to seeing electricity doing almost anything, from turning the turrets of a battleship to drying Milady's hair; but deliberately to walk across the face of a perfectly good clock set in the floor is a decided novelty.

The dial is of plate glass, 2 feet in diameter and 1 inch thick, the numerals and minute marks being etched on the under side. Under each hour sign is a tungsten lamp, the entire mechanism and lamps being contained in a metal box 10½ inches deep, painted white on the inside, so that the illumination is brilliantly striking, and the shadows cast by the hands exceedingly dark.

The clockwork is driven by a spring, wound every five minutes by an electric motor obtaining its current from a battery of three "dry cells," and the time is regulated automatically every hour by telegraphic connection.

In some ways it seems more convenient to "get the time" by looking down rather than up, as most of us are accustomed to do, the only drawback apparently being that it is necessary to stand in the right position with reference to the clock face, or else acquire the facility of reading the time "upside down," which to most people would be somewhat awkward at first, although the knack soon would be acquired.

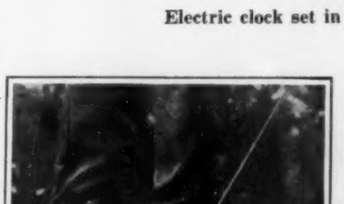
Electric clock set in the floor of a hotel lobby.

Professional Snake Catchers

THE German government regularly employs men attached to the forestry service to exterminate poisonous snakes. The snakes are not found in great numbers, but are sufficiently numerous in mountainous and wooded districts to constitute a menace to women and children picking berries or collecting wood, because these people generally go barefooted. The snake-catcher wears thick cowhide boots through which the snake is unable to push its fangs.

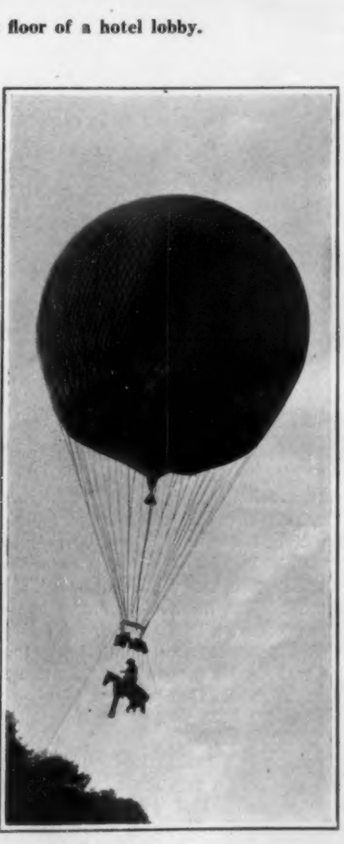
In catching snakes the man uses a pair of hinged sticks, like pincers, which he presses against the snake's neck immediately behind the head, thus making it powerless to move its head. Some care must be taken, because the snake will sometimes eject its poison, and if this should enter a scratch or cut, it would cause the same effect as if the catcher had been bitten. While the snake is in this position, the catcher grasps its tail and throws it into a strong leathern bag with a swing, releasing the neck. The bag is securely tied and the snakes carried home, there to be disposed of.

The poisonous snakes of Germany are mostly adders, and the one most frequently met is the *Pelias Berus*, or Cross Adder, so called because its back is marked with a cross-like pattern.



Seizing the snake with the wooden pincers.

A professional snake catcher.



A thrilling "movie" adventure.

Twenty-four Hours in the Air

THOSE in charge of the Wanamaker transatlantic expedition must surely find encouragement in the remarkable performance of Reinhold Boehm, the German aviator who at Johannisthal on July 11th achieved the feat of flying continuously for 24 hours and 12 minutes.

His was an ordinary army Albatross biplane, fitted with six-cylinder 75 horse-power Mercedes engines, and carrying 132 gallons of gasoline. It was the same machine in which Landman's record of 21 hours and 49 minutes in the air was made on June 28th. His provisions consisted of a vacuum bottle filled with cold milk, several packets of chocolate, and a few cakes.

He ascended easily, and in order to save fuel flew slowly around the aerodrome at first, not going higher than 300 feet. As the night wore on and the signals flamed out he went higher, and for an hour or two he left Johannisthal, flying across Berlin and Potsdam.

Returning to the aerodrome at midnight, he resumed his weary circuit. How many rounds he made nobody knows.

Boehm must have covered about 1,350 miles, as his speed averaged 47¼ miles an hour throughout.

Relative Motion and the Automobile

AT a recent meeting of the session of the British Institution of Automobile Engineers Dr. A. M. Low gave a very interesting lecture on "Some Experiments and their Bearing on the Design of Automobile Parts."

The line taken by the author was to advocate the study of the motion of the different parts of the car from the point of view of the actual parts themselves. Dr. Low instanced the carbureter, which is adjusted with extreme care as to the weight of the float, etc., and is then fitted on an engine which is vibrating in such a way as to upset the accurate adjustments made. He stated that he had fitted an instrument, which he terms the "Chattergraph," for observing the action of the brake-shoe on the drum; the instrument showed clearly that the motion of the shoe in relation to the drum is a constant series of rotations of the whole drum with the shoe, alternating with a movement of the shoe in the drum. He pointed out that there are three methods of studying motion—the rotating mirror, the alternating generator with variable period, and kinematograph. He strongly advocated the use of the kinematograph by automobile designers for the study of the motion of the various parts of a car, and exhibited some experiments indicating the results which could be obtained. One of these experiments showed the action of a valve lifted by a cam, and the lecturer pointed out the bouncing of the valve off its seat with improperly shaped cams. He also gave the results of experiments on an induction pipe fitted with a glass window with two eye-pieces and a shutter revolved by means of a cam from the engines; by this means the actual form of the globules of oil mixed with the gasoline could be traced in various positions in the pipe.

An Aerial Ride on Horseback

A GERMAN moving-picture manufacturer has turned out a film that shows a novel and very sensational feature. A bandit chased by soldiers is nearly caught when he catches sight of a balloon very opportunely tied to a post and awaiting his pleasure. He ties his horse to the balloon and unties the mooring rope. Immediately he is carried into the air, and the soldiers cannot get him. The film shows the balloon, with horse and rider fastened to it, sailing through the air, until it finally collapses and drops into a sheet of water, whereupon the bandit loosens the ropes and escapes. The remarkable feature is that this exploit was actually executed, and a live horse and rider were tied to the balloon, as is shown in the accompanying photograph.

The Motor-driven Commercial Vehicle

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The Editor will endeavor to answer any questions relating to mechanical features, operation and management of commercial motor vehicles.

Novel Truck for Aeroplane Transport

By Our Berlin Correspondent

A NEW type of aeroplane transport has been designed by a German engineer, which dispenses with any special tractor. Hence it may travel backward and in loops, which is a most important feature from a military point of view. Moreover, the aeroplane is supported at its most delicate points, thus avoiding any distortion or injury.

While special repair cars accompanying the aeroplanes have been used with success at the French army maneuvers, this truck has itself been designed as a traveling repair shop, carrying all exchange parts and tools. The speed of traveling can be increased up to 40 miles and more per hour, which is a decided advantage over ordinary transport vehicles traveling at 12 miles, as, in the event of breakdown to the aeroplane, assistance can be thus obtained much more speedily.

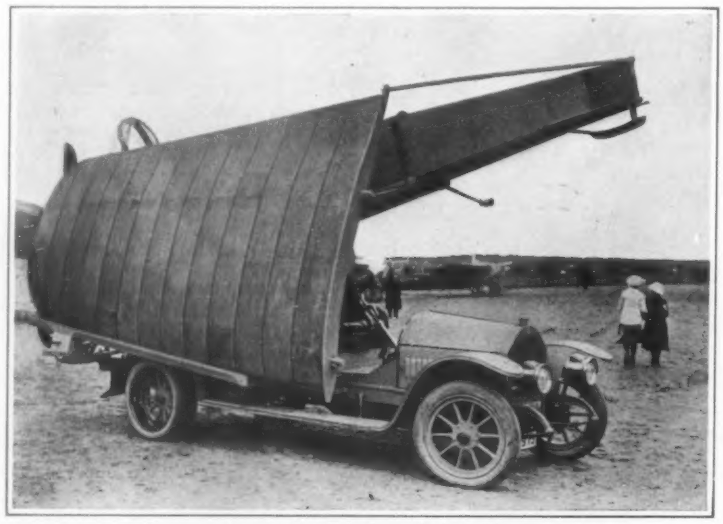
The body of the vehicle is fixed to the two axles and strapped to a tipping device. The supporting planes of the aeroplane are strapped to two upholstered guides. Seating accommodation for four men and room for a bed is provided. A tarpaulin carried on the truck dispenses with necessity of an aeroplane tent. The aeroplane is loaded on the vehicle and covered with the tarpaulin, as the night comes on, so as to be always ready to start operations. The same tarpaulin, of course, serves to protect the aeroplane, while under way, against injury by branches, etc.

Lessons from the Railroads for the Truck Owner

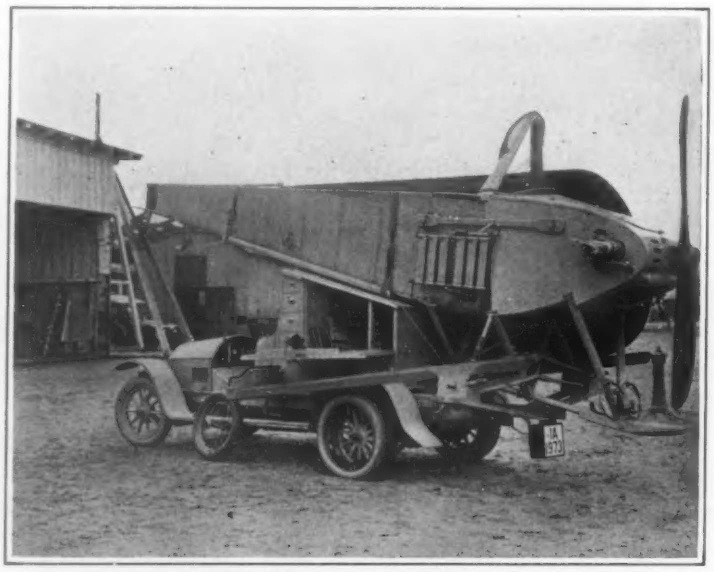
By H. S. Whiting

TO those who have observed the numerous lines of interurban express and delivery companies that make use of the motor truck for the transportation of freight and merchandise between cities many miles distant, it might be assumed that the commercial vehicle is becoming a serious competitor of the railroad for short hauls. Possibly for the purely local traffic, the motor truck has, in a measure, supplanted the freight car, but that at no gross loss in the business of the railroads. In fact, rather than proving a competitor of the railroads, the motor truck now assumes the guise of their ally, and through improving the shipping facilities of points distant from the railroads, new territories have been opened that had never been extensively "tapped" by the railroads. Every passable highway is now a feeder for the railway toward which it leads, and where horses formerly hauled their hundredweight, motor trucks now carry their tons.

But the motor truck owner must learn his lesson of efficiency from the railroad if he would obtain the most from his installation. Through a wonderful system of grouping and arrangement of different cars with various consignments, freight is now handled with a minimum of loss in time and labor, from the moment the goods are delivered at the station until they reach the freight yard of their destination. But this efficiency does not begin until they are delivered to the railroad company, and it ceases as soon as the goods pass out of their jurisdiction, for trucking systems at the freight terminals are notoriously inadequate. In fact, so inefficient have been the systems whereby freight was delivered to the shipping platform and hauled away, that in some instances the railroad companies have endeavored to install systems of their own.



Aeroplane transport, showing the upholstered wing-support.



One of the wings removed to show the repair shop.

The ideal motor truck system would be one in which the vehicle could be sent with a normal load on both the outward bound and the return trip, and would be forced to make only a minimum number of stops during its journey. The railroad companies long ago taught us that it cost nearly as much to haul an empty car as it did one that was loaded; and while the wear on tires and the gasoline consumption of a truck running "light" may not be quite as great as is the case when it is filled to normal capacity, nevertheless, the former is naturally a non-productive trip, while the latter is the work for which the truck was designed and for which it is expected to show a profit. But in spite of this basic principle of transportation theory, we constantly find three and five-ton trucks proceeding to the freight terminal with 100 and 200-pound loads, and then the truck owners complain that the vehicle does not show a profit. The department stores learned long ago that a light, high-speed delivery wagon for small parcels and a heavy truck for bulky goods formed a combination far more profitable than the use of a single vehicle for both purposes. But the department store delivery truck cannot, as a rule, travel loaded in both directions, and the return trip must be made practically empty. If the freight truck could run to the terminal with a full load, and exchange this for another to be delivered throughout the city, it could be made to show a handsome profit throughout every foot of its progress. But to do this, we must presuppose a system of interchange of orders and the distribution of the goods to be picked up and delivered by localities so that the various trucks could be loaded in the shortest possible time. This would necessitate a compact organization, and as most of the trucking to and from our large terminals is done by small, independent companies or individuals, the day of the efficient handling of freight is still in the distant future.

Next to the small loads that are carried by many of the vehicles doing a terminal trucking business, the time lost at the loading and unloading platforms proves the greatest source of lost efficiency. Driver's wages, insurance, depreciation, and interest on the investment continue, whether the truck be idle or in motion, and the loss of a few minutes time at each platform on each trip may make all of the difference between a profitable and an unprofitable installation. To overcome this difficulty, removable cages or inclosed, detachable bodies have been devised which may be quickly secured to the platform of the truck. This enables one body to be loaded while the contents of another are being delivered, and by this means the truck is kept in operation throughout the greater part of the day. But such a system is only applicable to a trucking or delivery business that collects the goods at one platform, and an installation in which the trucks obtain their loads by the "pick-up" method at various points cannot employ these labor and time-saving, removable bodies.

But in spite of modern equipment, trucks that deliver goods to congested freight terminals in the railroad yards or at the wharves cannot realize fully on the investment represented if time must be lost while "waiting in line." Loading and unloading platforms must be large enough to accommodate the traffic, and if arrangements could be perfected whereby deliveries and collections at the terminals could be more evenly distributed throughout the day—and night, if necessary—far more efficient service could be obtained. Of course, the short time allotted to the loading and unloading of a transatlantic liner makes congestion at the piers inevitable, but with the daily and hourly departure of freight trains, it would seem that various consignments could be sent through on schedule in much the same manner as the trains themselves arrive at and depart on a certain prearranged time. A motor truck is not only a road locomotive, but a train of several load-carrying cars, as well, and when it is delayed, the proportionate loss encountered is equal to that entailed by the tie-up of an entire freight train.

But let it not be inferred that traveling at full load with a minimum amount of delay is the only requisite for a successful truck installation; to be "busy" is not the only mission of a truck; the routing of an ordinary delivery system is as important as are adequate loading facilities and the elimination of delays *en route*. This point is well illustrated by the experience of a large department store in a certain metropolis of the Middle West. The store in question installed thirty trucks of a well-known make on the representations of the dealer, who was sincerely certain that the new delivery system would show a marked saving in expense over the old horse system. The management of the trucks was delegated to the delivery superintendent, who had been with the firm for years, and who was familiar with every inch of the territory covered. The machines were to be cared for in the garage of the agent, who was to inspect them daily, make all necessary repairs and adjustments, and furnish all gasoline and oil for a stated sum per month. The driver of each truck was to do no more than operate the vehicle and deliver the goods, and any roadside adjustments to be made or troubles to be remedied were to be undertaken only by the experts furnished by the agent. It seemed as though conditions were well-nigh ideal for the success of the first all-motor delivery system in the city in question.

But there was a leak somewhere; the thirty one-ton trucks did not seem able to perform the work of an equal number of one-horse delivery wagons. The trucks would leave the shipping platforms well-loaded each day, and their odometers indicated a mileage even greater than was to have been expected. But the agent, sure of the ability of his trucks, went deeper than mere weights of loads and daily distances covered, and his investigations soon brought to light the real reason for the seeming failure of the truck delivery system.

The entire difficulty lay in the routing of the vehicles; several trucks would cover the same territory, and the same streets would be traversed two or three times by the same machine; small packages that should have been delivered by a boy were sent in trucks to houses only two or three blocks distant; two or three of the trucks would be loaded with pack-

ages for both the southern and northern portions of the city. In other words, the trucks were loaded with consignments with no regard to their distribution by localities. Further investigation disclosed the fact that the delivery superintendent, in whom implicit confidence had been placed, had intentionally so arranged the routing of these trucks that they would not compare favorably in cost with the old horse system of delivery; and it was proved that his interest in the horse system had been based on a certain commission that he had been receiving from the company from which the store had previously purchased its horses. The dismissal of the delivery superintendent and a proper rearrangement of the routing resulted in a marked change in delivery expenses, and the trucks from that time on have shown a most satisfactory saving over the former horse system.

Motor Truck Notes and Queries

L. P. C. writes: "Have any of the States enacted laws indicating the width of tires that should be used with loads of given weights? Of course, a narrow tire will cut a road more than will one of a greater width used with the same load, for in the former case, the weight is concentrated on a smaller area of tire contact. However, I do not know whether any of the States have taken cognizance of this fact."

A. Some of the States have passed laws indicating the tire widths that should be used with loads of various weights. Others have only specified the amount of the load that is allowable per inch of width of tire. In such instances, the meaning is not exactly clear, for it is obvious that the width of contact (which is really the determining factor in road wear) is not necessarily constant with different kinds of tires of the same width. For example, a flat, steel tire will have its full width in contact with the road, and will not cut the surface as badly as will a rounded rubber tire of the same width at its base and carrying the same load. Because of the circular cross-section of the pneumatic tire, the length of its "line of contact" with the road surface is least of all; but as only comparatively light loads are carried on pneumatic tires, this phase of the question is not as serious as might be the case otherwise.

N. K. D. writes: "I employ a 5-ton truck that is used only on hard, level roads. The power of the motor seems ample to haul double this load under these favorable conditions, but of course this would soon ruin my tires. I do not like to use the surplus power of my motor for obtaining excessive speed, and would therefore welcome a suggestion from you as to the best way to get the most out of my truck."

A. The conditions of operation of your truck seem to make it unusually well suited to the use of a trailer or a series of trailers. You have exactly the right ideas as to the harmfulness of overloading and excessive speeds, and we believe that the use of a trailer will enable you to retain all of the advantages of both without their disastrous consequences. As you may know, trailers are trucks especially constructed to be attached to a motor vehicle, and thus to enable the former to haul double its normal load without extra strain on tires or running gear. If several are to be drawn, the rear axle, as well as the front, of each is designed to swivel so that each will follow in the track of its predecessor, and sharp turns may be negotiated as readily as though only the one truck, or tractor, were involved. Some special types of trailers are designed with a spring tongue or coupler, that enables the load of a series to be taken up gradually, so that the truck can be started easily without undue strain. The effect of these springs is similar to the result obtained when a heavy freight train first moves backward a slight distance in order that there will be "slack" throughout the train, so that the engine may take its load gradually as it assumes headway.

Did Prof. S. P. Langley Invent the First Practical Flying Machine?

(Concluded from page 59.)

posed in the wake of those in front, but recent developments show often a studied sacrifice of efficiency in the interest of safety. In comparing Langley's work with that of the Wrights and their French imitators, the fundamental difference must be kept in mind, that Langley somehow *considered himself scientifically bound to solve the problem of inherent stability.*

That was why in his eyes it seemed of paramount importance to experiment with very large, unmanned models. Will his merits be at last appreciated, if we see the aeronautic scientists of this day, especially the English and German students, bend all their energy, as he did his, to this same problem of inherent stability, and if we see Orville Wright himself, in pursuit of the identical aim in his newest flying-boat, going so far as to adopt the old Maxim-Langley principle of a dihedral angle? The success of the large Langley models is undoubted. But we are apt to overlook the most perfect of them, which had an explosion motor, and which really surpassed the sensational steam model which flew in a calm in 1896. We are also apt to overlook the long series of flights made both by the second and the first steam models under varying conditions, some in considerable wind. These flights were undertaken to furnish a basis for designing the improved explosion motor model and man-carrying machine, which was only four times larger.

To Langley belongs the merit of having anticipated, by the general trend of his mind and his intense sense of scientific responsibility, the most important achievement of to-day—knowledge of the effect of proportioning the different parts of an aeroplane to secure stability.

This science has been systematized wonderfully in England. Langley, realizing its full importance more than a decade ago, thought it a most complex art to which, "for lack of a better term, he wished to apply the name of *aerodromics*."

The longitudinal stability of the Langley machine is irreproachable, because in the man-carrying machine he employed, in addition to the features which made its exact counterparts, the models, so automatically stable, the same means—a rear elevator—that controls the Wright machine. It had, in addition, inherent stability from properly proportioned following surfaces, and automatic stability by employing its rear elevator as an elastically connected Pénaud tail, a device according to Chanute's testimony, invented (and communicated to Langley), but unfortunately abandoned, by A. M. Herring. The "Pénaud tail" is, moreover, only a different name for what the French now call a "V" between planes and tail. Tandem surfaces as used by Langley do waste power, and in view of the recent Hammondsport difficulties it may be of interest that Prof. Langley's engineer, Charles M. Manly, told the writer in 1905 that if he were to continue the experiments he would put wheels under the machine and fly it over land.

The question remains: can the machine fly without the Wright control to help? To this there is the answer that a prominent school of aviators, whose most notable exponent is Helmuth Hirth, the German champion, prefers the use of the rear rudder alone and reliance on a zig-zag course to wing warping, and a straight course for lateral stabilizing in gusts. Since the Langley machine has an efficient rear rudder it ought to fly if not loaded too heavily.

Further, as was to be expected from the strictly *practical* nature of the experiments with the big Langley models, the dihedral angle is so proportioned that, as in the newest Wright aeroboat, it is a valuable help and not a hindrance to lateral stability.

The most elucidating criterion is furnished by a comparison with the German "Fokker" machine, in which the dihedral angle has been so skillfully used that, in spite of the absence of any wing warping devices or ailerons, it meets successfully

the exacting demands of German military service. This has been accomplished by simply placing the center of gravity high enough. A side gust encountering nearly as much "dihedral surface" below as above it, thus balances itself as to the upsetting effect. A side view of the Langley machine shows, likewise, considerable wing surface below the center of gravity. What is still lacking, in comparison with the "Fokker," is supplied by the identical effect of the "keel surface" of the body of the long "boat," inclosing the boiler in the steam models, and the position of the vertical rudder in the gasoline machines. Then, too, why have the long, light cylinders for floating the models on the water been placed below and not above the center of gravity?

Watercycle Races at Enghien-les-Bains

(Concluded from page 56.)

part; at 2:45, first heat of the first class; at 3, first heat of the second class; at 3:15, heat of the third class; at 3:30, heat of the fourth class; at 3:45, final heat of the first class; at 4, final heat of the second class; at 4:15, parade of the miscellaneous machines past the judges; at 4:30, race of the fifth class; at 4:45, race of the sixth class; at 5, race of the seventh class; at 5:15, Omnium race, obligatory on all contestants.

Each race for the classes was over a distance of 900 meters, or three times round the course; the closing, Omnium race, was over a distance of 2,400 meters, or eight times around the course. The prizes for the races by classes were medals of silver-gilt, silver, and bronze; for the final, Omnium race, the prizes were in money, ranging from 200 francs as first prize to 25 francs.

The machine which proved the most successful was the one constructed by M. Louis and piloted by himself. It won the race for the first class over five other competitors in 5 minutes 49 seconds, and the Omnium race in 15 minutes 31 2/5 seconds. The picture given of it shows the simplicity of its build. There are also pictures of two other contestants of the first class, the Dutheil machine which came in third, and the Duguet machine which came in fifth. The race for the second class was won by the Bernhardt machine piloted by Begnez, in 5 minutes 53 seconds; the same machine, with the same pilot, was second in the Omnium race, being ten meters in this behind Louis. The Bernhardt machine had already been the winner in another meet held elsewhere before this. The third class race was won by Lagrand's propeller "Kano" in 6 minutes 7 seconds; this machine, which was mounted in a very light canoe hull, and piloted by its owner, was third in the Omnium race. The only fourth class entry could not appear on account of an accident. In the race for the fifth class, the machine "Schweitzer IV," piloted by Camus, had the course to itself, as its rival met with an accident in the garage. The only entry in the sixth class, the machine "Schweitzer V," piloted by the younger Schweitzer, had naturally a walkover. In the race for the seventh class, the machine "Cailliez," piloted by Cailliez, won in 7 minutes 50 seconds; the same machine was fifth in the Omnium race. We give a picture of this machine. The Schweitzer machines, of which we give two cuts, one showing an aerial propeller, are called "hydrocars," and lay more claim to comfort and security than to speed. Among interesting entries of machines which were not winners was Bénégent's machine, called the "Autobus"; this machine can carry six people, and received a medal from the jury.

In discussing the impressions of the race in its issue of the next day, *L'Auto* emphasizes the simplicity of structure of the Louis machine and the ease with which it can be managed, as making it a good type of a quick, light, and well-balanced water-cycle. It then says, in brief, that the two points in which the builders of water-cycles evidently need to seek improvement are the floats and the propellers. All the contestants whose machines were mounted on floats had difficulties on this account, except the winner Louis, whose floats had the least contact with the water, and came the nearest in excellence to the floats of a hydroaeroplane. The pilot did not have to work hard in pedaling this machine, while its speediest rival, the Bernhardt machine of the second class, was driven along the water with considerable effort. As regards propellers, the question of aerial propellers versus water propellers is still an open one. The wind that blew at the time of the race was a deterrent to the machines with aerial propellers, so that as far as this race is concerned, the propellers under water can claim the victory.

An Alpine Museum

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The most important trees of the tree limit, viz., pine, fir, larch, sycamore, maple, etc., are exhibited in photographic reproductions from Fischbach's original drawings. Dried samples and preparations kept in formaline water show in a natural state the most important parts of these trees and of the mountain juniper. A special diagram informs the visitor of the season of snow melting and snow-falls at various altitudes. A schematic, ideal landscape illustrates the various regions of vegetation in a given part of the Alps, from the valley to the snow-clad peaks, the altitudes above sea-level being marked by lines. Special attention is given to such beautiful Alpine flowers as edelweiss, gentian, etc., which are threatened with extinction and for the protection of which energetic measures are being taken.

The longitudinal wall of the hall is taken up by four cabinets devoted partly to ethnography and partly to the history of Alpinism and the development of mountaineering. Many specimens relating to the customs of the inhabitants of Alpine countries, such as richly decorated spinning wheels, doll cradles, embroidered belts, knives and forks of embossed silver, inlaid spoons, pocket altars, watches with compass, etc., form the beginning of an ethnographical collection. Popular costumes are likewise represented by a number of models and painted wooden figures.

Panoramas and maps could unfortunately be given only a rather limited space. An earth profile of the zone intermediary between 31 and 65 degrees northern latitude at the scale of 1 in 1,000,000 gives a strikingly distinct idea of the ratio between the size of the earth and the elevations and depressions of its surface. In order to give an instance of its wonderful instructiveness, it may be said that this profile readily shows why the lightning flashes of a thunderstorm in the Drau Valley, in spite of an intervening distance of 166 kilometers can still be observed in Munich as reflected sheet lightning. Some optical instruments, ancient and modern, for the use of mountaineers are contained in a glass case on the southern side.

In the northern colonnade, we are struck by the comprehensive view of first ascents in the Eastern Alps. An attempt has been made here to give a chronological picture of the opening up of this part of the Alps, as far as the first ascents can now be ascertained. We thus see that all the more important peaks had already been ascended before the forties of last century, when a powerful development commenced, leading to the systematic opening up of the mountains.

The hygiene of mountaineering is illustrated in many ways. Numerous diagrams and curves impart useful information on the number of blood corpuscles corresponding to various altitudes and to rapid changes in altitude, the causes and symptoms of mountain sickness, the average consumption of breathing air in overcoming a given level difference at different altitudes, the consumption of energy in ascending and descending, as well as on the level and differences in the efficiency of the organism with and without a moderate consumption of alcohol. The importance and growth of Alpinism is strikingly shown by a collection of present-day periodical Alpine literature, which even includes South Africa and Japan.

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